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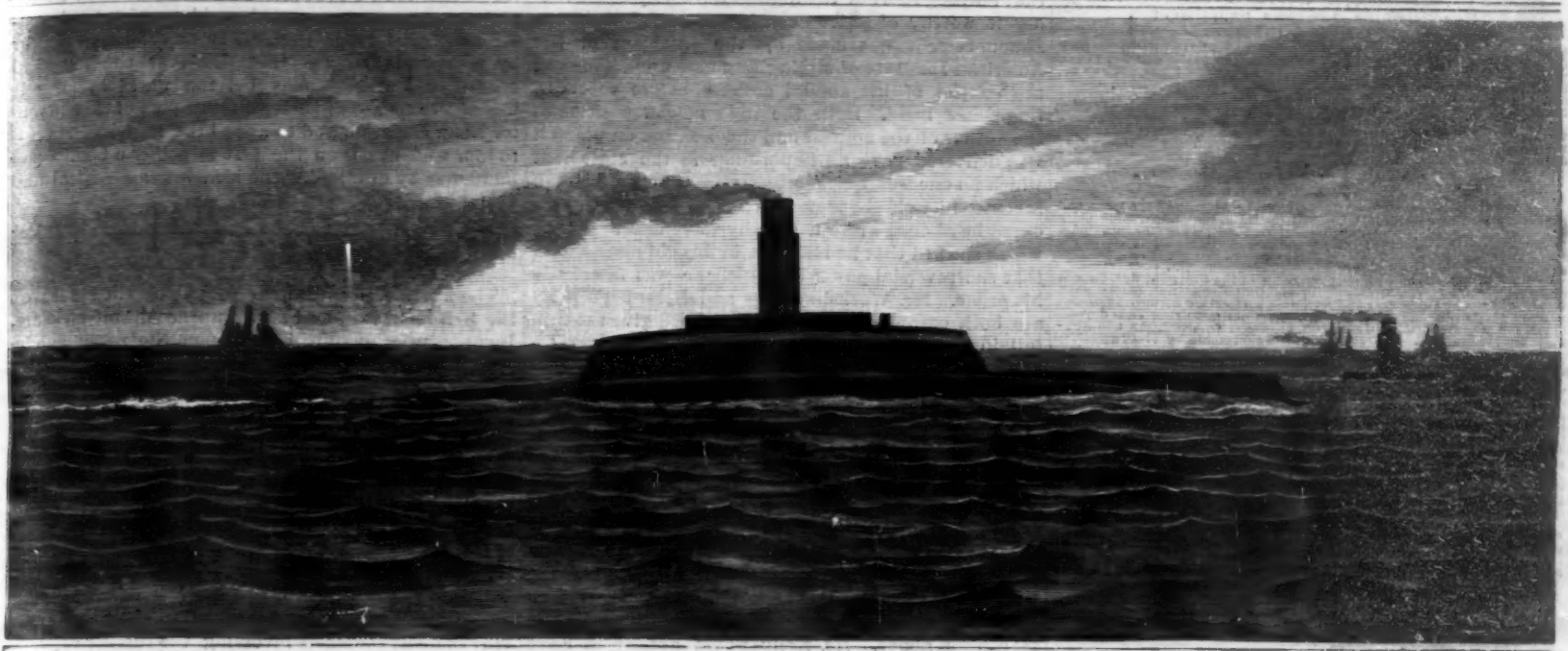

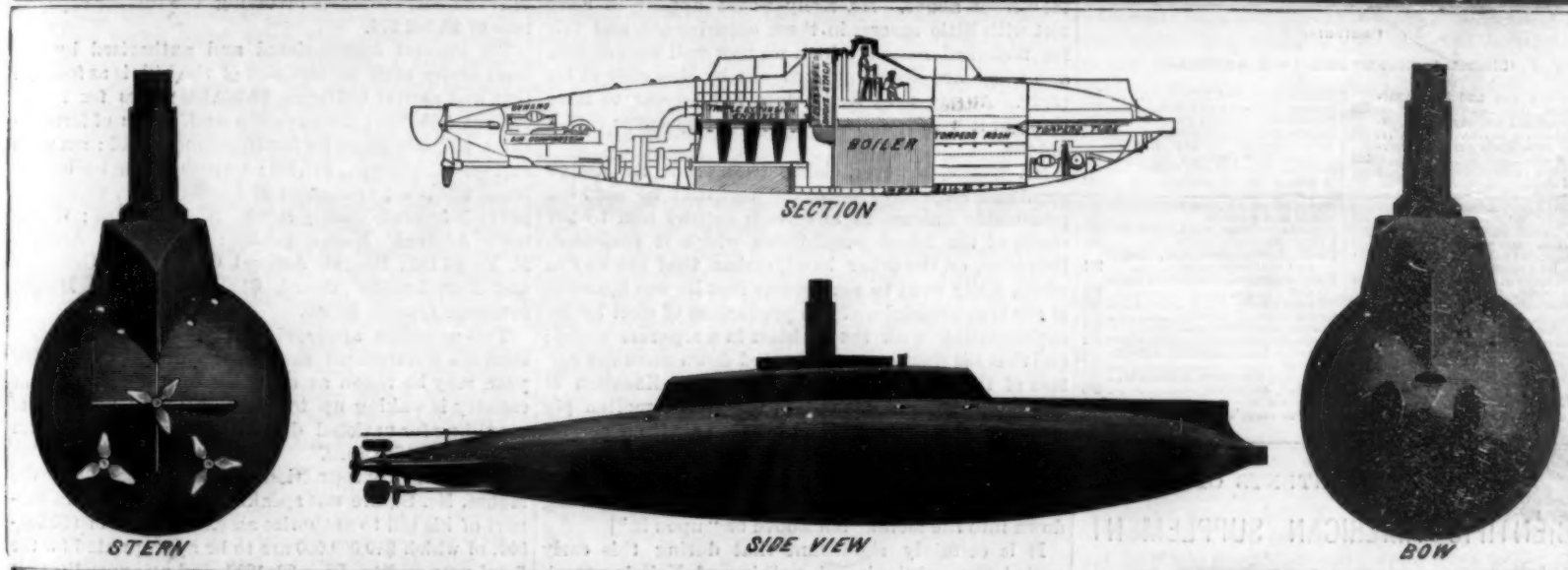


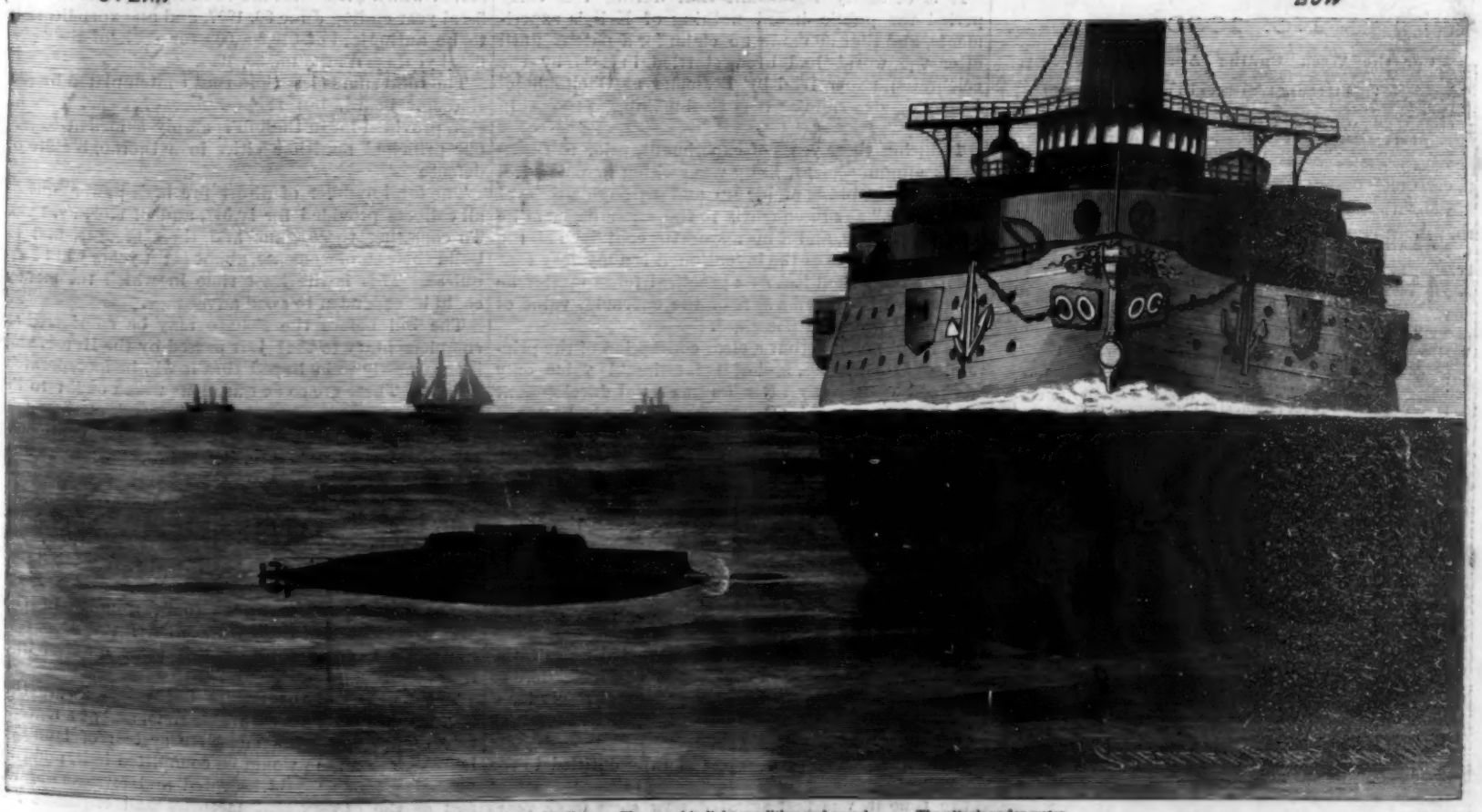

Sections and elevations of hull. The vessel in light condition and awash. The attack under water.

**THE HOLLAND SUBMARINE TORPEDO BOAT.**—[See page 263.]

# Scientific American.

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NEW YORK, SATURDAY, APRIL 25, 1896.


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(Illustrated articles are marked with an asterisk.)



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SCIENTIFIC AMERICAN SUPPLEMENT

No. 1060.

**For the Week Ending April 25, 1896.**

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## THE INVENTION OF THE BESSEMER PROCESS.

The recent controversy between the aged Sir Henry Bessemer, who carries his knighthood by virtue of the fact that he has been considered the inventor of the famous process which bears his name, and Mr. Joseph D. Weeks, president of the American Institute of Mining Engineers, who disputes his right to the glory of the invention in favor of William Kelly, formerly of Pittsburg, Pa., and lately deceased, is notable both for the unexpected nature of the claim and for the high position of the contending parties.

The statement that the Bessemer process is not Bessemer's is so startling and seemingly so improbable that nothing short of the highest authority could render it worthy of serious consideration. As it is, the announcement was made by the president of the American Institute of Mining Engineers, and it formed the subject of his annual address before that distinguished body. Both the high official position of the author of the address and the occasion on which it was delivered gave an importance to the statement which no one was quicker to realize than the veteran inventor himself—he is now in his eighty-fourth year—and he at once wrote a lengthy reply to Mr. Weeks, which showed that he had lost in his old age none of that controversial power for which he was famous in his prime. Mr. Weeks' address and Bessemer's reply are both extremely interesting, and we give them in full in the current number of the SUPPLEMENT, together with a reproduction of the drawings accompanying the original patents granted to Bessemer and Kelly by the United States Patent Office.

Briefly stated, the facts of the controversy are as follows: In 1847, and from that date on to 1851, when he appears to have given up in discouragement, Kelly was experimenting with an apparatus for blowing air upon fluid iron for the purpose of refining it. The apparatus was crude, and as far as the evidence goes no attempt was made to force the air up through the body of the metal itself, as the blowing was all done by one tuyere, which was "swung down into the metal" from above. Mr. Kelly would appear to have met with little success in these experiments, and this for technical reasons which we now well understand, and which are clearly pointed out by Bessemer in his reply. At any rate, Kelly does not appear to have thought it worth while to cover his apparatus with a patent.

Mr. Weeks, however, claims that, crude as Kelly's appliance may have been, the fact that he used the pneumatic process in any form entitles him to the credit of the latent possibilities which it possessed. Bessemer, on the other hand, claims that the way in which Kelly went to work shows that he was ignorant of the true principles of the production of steel by decarburization with the air blast in a separate vessel; and that his single tuyere directed down upon the surface of the molten iron was merely a modification of the old "finery furnace," in which the molten pig was slowly decarburized by blowing air from several tuyeres upon its surface. [In this, it should be noted, Bessemer does not quote correctly the description of Kelly's tuyere, which is spoken of as being "swung down into the metal," not above or "upon it."]

It is certainly significant that during this early period the public heard nothing of Kelly's experiments, and that he made no claim for a patent until after the world had been startled in 1856 by the celebrated paper read by Bessemer at Cheltenham, England, describing his steel-making process in detail.

If during these years of experiment, prior to Bessemer's announcement, Kelly was seeking to make steel by "blowing blasts of air up and through a mass of liquid iron," as subsequently to the announcement he asserted he was, and if his apparatus contained all the essential features of the invention, it is a mystery that he did not patent it. As a practical forge master he must have been well aware of the enormous value of the secret which he possessed.

Is it not possible that a clear conception of the principles of the process, and of its inestimable value, only dawned upon Kelly after its successful development and announcement by Bessemer; and that he hastened to claim (in all honesty let us admit) a substance of which he in reality had only possessed the shadow?

Mr. Weeks has brought forward his claim in good faith, and has gone carefully into the subject, and his claim for Kelly is based principally upon the interference proceedings, which were instituted at the time, and which were favorable to Kelly's claim and which enabled him to procure his patent. Whatever glory from a legal point of view Kelly obtained from the issuing of this patent, the hard facts remain that whatever apparatus he had ever constructed was of the crudest description, and the results obtained were so unsatisfactory that he did not proceed to apply for a patent until some eight or nine years after his first experiments took place.

The question as to who was morally entitled to the credit of this great invention was well thrashed out, at the time it was first agitated, now some forty years ago; and the accumulated honors which America has showered upon Bessemer showed that the public at large decided it emphatically in his favor. This tribute of the American people was the more remarkable and conclusive because it was rendered with the full knowledge that there were in existence the rival patents of their own countryman Kelly. It is abundantly evident that the people of that day who were in touch with all the facts of the case, and had access to the evidence, concluded that, whatever technical claim Kelly had established upon the invention, the moral claim belonged to the man who had put it into a practical mechanical shape.

It seems as if the true standard of invention should rest upon the broad basis of public service or utility and not upon a mere nebulous idea which the inventor has failed to develop. The object lesson taught by the controversy is that whatever the technical nature of the claim may be, the world at large is inclined to regard diligence on the part of the inventor as an essential, and to award the laurel of success to him who has been the first to confer a boon upon humanity by developing the idea into a practical and useful invention.

## PASSAGE OF THE FORTIFICATIONS BILL.

The Fortifications Bill, as passed by the House on the 14th inst., is in every way an admirable measure. Its appropriations are based upon the recommendations of the Endicott board of 1885, which made an exhaustive examination of the various harbors and sea coast cities, and devised a complete system of land fortifications, whose total cost was to be $100,000,000. It is evident that such a large sum could not be immediately expended, for the reason that our plant for making guns and mounts has an annual capacity of only 10 per cent of the material represented by that amount of money.

The present bill authorizes a total expenditure of $11,384,613, of which sum $5,842,337 is specifically appropriated, and authority is given to the Secretary of War to make contracts involving the further expenditure of $5,542,276.

The amount appropriated and authorized by contract under each subdivision of the bill is as follows: Gun and mortar batteries, $5,260,000; sites for fortifications, $250,000; preservation and repair of fortifications, $50,000; plans for fortifications, $5,000; sea walls and embankments, $17,975; torpedoes for harbor defense, $100,000; armament of fortifications, $5,502,673; proving ground, Sandy Hook, N. J., $38,000; Watertown Arsenal, Mass., $43,500; Watervliet Arsenal, N. Y., $3,105; Benecia Arsenal, Cal., $4,500; Ordnance and Fortification Board, $100,000; Fortress Monroe sewerage system, $9,860.

This generous appropriation, which is even larger than the government can expend during the ensuing year, may be taken as a pledge of the fact that the country is waking up to the imperative necessity of providing for national defense by means of a system of coast fortifications.

While this appropriation was being passed by the House, Mr. Squire was speaking in the Senate in support of his bill to authorize an expenditure of $80,000,000, of which $10,000,000 are to be appropriated for the fiscal year ending June 30, 1897, and an expenditure is to be authorized of $10,000,000 for each of the seven fiscal years ending June 30, 1904.

The total sum is less than that contemplated by the Endicott board, but the number of guns, mounts, etc., provided for in the bill is amply sufficient to put our principal maritime cities in a thorough state of defense.

The total number of direct fire high power guns of all calibers provided for is 517, and of mortars, 1,056. To construct these guns and their mounts, and to build their emplacements, about eight years will be required. This is the least time in which the money could be expended to good advantage.

The bill before the Senate may be considered as complementary to that just passed by the House, and it is earnestly to be hoped that it will be incorporated with it. There are some questions which ought to lie beyond the reach of party politics, and of these the question of national defense is first. The considerations which have led to the appropriation and authorization of over $11,000,000 for immediate works of defense are equally cogent for the authorization of the other $70,000,000. These considerations are strong today, but they may be weak and futile to-morrow. We are just now involved in, or threatened with, international complications, and the views of Congress on national defense are certain to be sounder in the presence of danger than those of a future Congress that may have to consider this same question in a time of profound peace.

The passage of the Squire bill would insure the completion within a measurable time, and at a regular rate of progress, of a complete system of land defenses. The nation would be committed to it, and the necessary funds would be voted and forthcoming as fast as the government factories and engineers required it.

### The Annual Exhibition of the New York Microscopical Society.

BY E. O. HOVEY.

The seventeenth annual reception and exhibition of the New York Microscopical Society was held in the American Museum of Natural History on the 14th of this month. Judging from the large number in attendance, popular interest in minute objects is not on the wane. About 4,000 tickets were issued, and fully 3,000 people came to the exhibition.

The catalogue contained a list of sixty-eight exhibits, most of which were divided up into several sections, so that the number of things to be seen was very large and comfortably filled the central and north wings of the mammal floor in the museum. Evidently no attempt at novelty was made by many of the exhibitors, for one could see such old standard objects as the head of a mosquito, the eye of a fly, arranged diatoms, and the circulation of blood in the web of a frog's foot, but there was much that was new or in the nature of advances along lines of recent research. Everything, both old and new, was received with delight by the crowd of visitors, however, and expressions of wonder and admiration could be heard on all sides during the entire evening.

One of the curiosities in the way of mechanical skill was the Lord's Prayer written with a diamond point on glass within a space $\frac{1}{175}$ by $\frac{1}{175}$ of an inch in dimensions. Under the microscope the 227 letters of the prayer were as distinct and legible as if written in the ordinary manner. This writing was done by an Englishman named Webb, and was accomplished by means of a system of levers attached to an ordinary pen. A still more remarkable feat was accomplished by the same man in writing the whole of the Bible, about 3,700,000 letters, in a space $\frac{1}{2}$ by $\frac{1}{4}$ of an inch in size. This second slide was also at the exhibition, but Stephen Helm, who exhibited them, did not bring with him a microscope adapted to displaying it. Another curiosity was the reduction of photographs to such small dimensions as to be scarcely visible to the unaided eye, and yet so clear as to come out in all their details under the microscope.

The fleas which infest mice, the grewsome mites from ordinary cheese, and the Uropoda, a mite parasitic on beetles, were some of the exceedingly minute forms of insect life that aroused the interest of many visitors. William Beutenmuller exhibited sections of trees from United States of Colombia which had been tunneled in all directions by the carpenter bee, and under a microscope near by he showed the mouth parts of the insect, the tools with which it had been able to do so much excavation. The vegetable origin of coal was demonstrated by means of a thin section of brown coal which showed the cells very perfectly. A mere glance at the microscopic beauties of which nature is lavish in the mineral kingdom was afforded by seven exhibits entered at and near the beginning of the catalogue. One set of these was a series of specimens of mica from the northern part of this city which inclosed between its lamellæ minute crystals of several other minerals. The most delicate of the mineral specimens shown was exhibited by Dr. W. G. Levison and consisted of microscopic crystals of calcite pierced and supported by extremely fine hair-like crystals of pectolite from the trap rock of the Palisades.

Some of the important applications of the microscope to the everyday life and health of man and to his business and comforts were on exhibition and were worthy of the closest study. One of these was a large number of bacteria and cultivations and photographs of them exhibited by Dr. Leteve and George Rambaud of the New York Pasteur Institute. The bacillus of tuberculosis (consumption) is so small that when magnified 800 diameters it looks to be not more than an eighth of an inch long. It was exhibited by H. B. Baldwin.

The microscopic character of iron and steel has received much study of recent years and many new facts regarding it have been learned within the past year or so.

Mr. P. H. Dudley, of New York, had a large and very instructive exhibit of micro-photographs to show the results of his work. By means of these, he illustrated the changes which take place and the compounds formed in the mass under treatment with heat. The photographs exhibited showed the results of study of the structure of 0·02, 0·14, 0·45 and 1·25 carbon steels.

At different temperatures different compounds of carbon and iron are formed, and steel is by no means a homogeneous material. Beginning with the normal ferrite or pure iron, with its admixture of carbon, increase of temperature produces molecular changes and recrystallizations, four stages of which are sufficiently definite to have received provisional names. These are, in the order of their appearance, troostite, cementite, martensite and sorbite (earlier called perlite). The relations of these to each other are of the highest importance in determining the adaptability of a steel to a particular use. Up to within a very few years it has been supposed that chemical composition determined the strength or desirability of steel for any use except in tools (where tempering was understood), but now the importance of structure as obtained by proper heat treatment, rather than composition alone, has begun to be appreciated for gun metal, armor and boiler plates, and even for steel rails. Mr. Dudley's work has lain especially in the last department, and has shown that it is possible to temper the heaviest steel rails and thus improve them greatly in every respect. His photographs showed that rails manufactured according to his system presented almost absolutely the same amount of deflection under the "drop test" for all the samples from very large lots, and such deflection can be calculated in advance. The steel is prepared for study by careful polishing and then by etching by weak nitric acid. The temperature is regulated and determined by means of electricity. Reflected light only can be used, of course, since iron is perfectly opaque.

One feature of the evening was the lecture by the retiring president, Dr. Edward G. Love, on the use of the microscope in the examination of textile fabrics for the detection of fraud in material, overweighting, and so on. The lecture was highly interesting and instructive and was illustrated by numerous lantern slides. In the main collection a series of microscopic preparations of various textile fabrics was shown to illustrate the lecture more fully. The series comprised wool, silk, cotton, and linen, and showed what materials are used in their adulteration by the manufacturers.

The officers of the society for 1896 are: President, Edward G. Love; vice president, Frank D. Skeel; secretaries, George E. Ashby and Rev. J. L. Zabriskie; treasurer, James Walker; curator, G. E. Ashby; librarian, Ludwig Riederer. The committee in charge of the annual exhibition was George W. Kosmak, George H. Blake and William B. Tuthill, and to them is due in large measure the credit for the success of the affair.

### Why We Are Right Handed.

There is a general belief that the greater strength and dexterity of the right side of the body is based more on habit and imitation than on any inherent difference between the two sides. In an interesting article in Chambers's Magazine Dr. R. A. Lundie tells us that this is not exactly the case. It is often the case that when the body possesses two similar organs, one of them shall do most of the work, while the other is perfectly capable of being trained to take its place, should the occasion arise. He advises the training of the left hand, therefore, at the outset, although he acknowledges that the preferential use of the right is based on natural reasons. Says Dr. Lundie:

"In all communities lefthanded individuals seem to occur, in somewhat varying proportions. Among ourselves, about one in fifty is said to be lefthanded. There is no doubt, from frequent experience, that the peculiarity is hereditary; so that we could not be much surprised if a race were met in which lefthandedness was the rule and not the exception. Yet the reversal of so general a law as that of prevalent righthandedness would need to be established by very conclusive evidence; and, though statements have been made as to a preponderance of lefthanded individuals in various parts of the world, none of them are supported by such careful and prolonged observation of facts as would be necessary for their unhesitating acceptance.

"One of the prevailing ideas about righthandedness is that it is merely a matter of training, and that lefthanded individuals have become so either from want of care on the part of nurses and parents or from imitation of some older person. In many children, the preference for one hand is shown from a very early age, before the child has learned to handle anything but the very simplest toys, and therefore before training can have caused a preference at all. More than this, the experience of lefthanded persons is on record in whom the peculiarity has been early noticed and combated, but without the slightest effect.

"It is well known that, though our external configuration is so nearly symmetrical, the arrangement of the internal organs is very different. The heart lies obliquely in the chest, and more to the left side than the right; the liver, by far the heaviest of the internal organs, is on the right side; the two lungs are differently shaped; and, moreover, the blood vessels supplying the two sides, especially in the upper regions of the body, are differently disposed. It is natural that these irregularities of arrangement should have been thought, in some way or other, to supply the explanation."

After describing a number of theories of righthandedness, based on the lack of physical symmetry in this and other respects, Dr. Lundie goes on as follows:

"There is, however, one extremely curious and interesting instance of want of symmetry in the bodily functions, which is not merely analogous to righthandedness, but closely linked with it. The nervous machinery normally connected with speech is situated on one side of the brain only. So intimate is the relation of this subject to righthandedness that we must consider it in some detail.

"It is well known that each side of the brain is connected with the movements and sensations mainly on the opposite side of the body; the right brain moves the left arm and leg, and vice versa. Now, cases are not infrequent in which, with or without 'a shock,' or at least some degree of obvious loss of muscular power on the right side of the body, the faculty of recalling and reproducing spoken words is totally or almost totally lost. Such loss of speech is technically called aphasia. It was first shown some thirty-five years ago, by a French physician, that this particular symptom is associated with damage to a limited and very definite part of the brain substance on the left side, which has since been known, in honor of its discoverer, as Broca's convolution. When the power of speech has thus been lost, it is possible, if the mental faculties are not otherwise damaged, to acquire it again, by just such a course of training and practice as the child passes through in learning to speak at first, even where Broca's convolution has been so damaged as to be quite incapable of performing its functions. In such a case, the portion of the brain on the right side corresponding to Broca's convolution is capable of taking up its work; but only by being educated to do so, just as the damaged portion of the brain had been originally. If after this the power of speech is lost again, by damage to the right side similar to that which had impaired the left, there is no hope of its being restored a second time.

"It is thus clear that there are two organs or portions of the brain capable of controlling speech; and that under ordinary circumstances only one of them is trained to do so, the other lying fallow. All the education is given to one favored side, and all the work is done by it; but the neglected one, if called by necessity to undertake the work, can be trained to do it, and to do it, apparently, as satisfactorily as the other. . . .

"Here, then, is a singularly complete analogy to the preferential use of the right hand: there are two sets of organs, either of which may be used for speech, one on each side of the brain, but only those upon one side are trained; only they have the education carried out which makes them effective. Yet if the educated centers are so damaged as to lose their functions, the others can be trained to take their place. So we have two hands, either of which may be trained for the performance of delicate movements: yet in most of us only one of them has been so trained; the other remains comparatively awkward and inactive, unless accident compels it to try to take the place of the educated hand.

"A striking analogy; but it is more than an analogy. We have said that the active speech center is that on the left side; and this is the case in the great majority of individuals. But occasionally it is found that the right, and not the left side of the brain has been educated as regards speech. When this is the case, it is always found that the individual has been lefthanded. Whatever then is the cause of righthandedness, it is closely associated with leftbrainedness, if we may use the expression, not only for the comparatively coarse movements of the hand, but for the fine adjustments of windpipe, tongue, lips, etc., which produce articulate speech, and the far finer machinery within the brain itself which registers our stores of words."

But although Dr. Lundie thus connects righthandedness and lefthandedness with anatomical and physiological facts, instead of regarding it as an accident or a result of training, he does not recommend that we should leave the other hand altogether helpless. He gives the following excellent advice on this point:

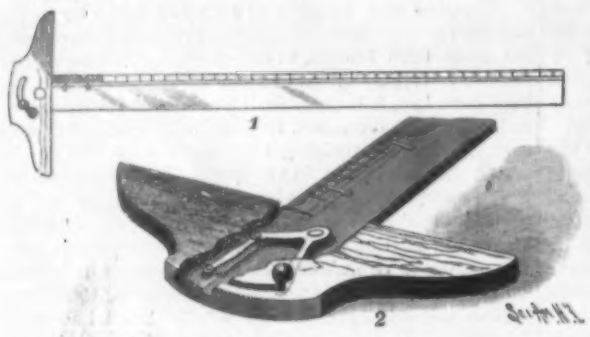
"When a child displays a decided preference for the use of the left hand, it is, as we have seen, useless to make forcible efforts to suppress it. By all means let the right hand be trained in writing, in using knife and spoon at table, and in as many actions usually righthanded as can be easily superintended. But the use of the left on other occasions should not be prevented; this will only diminish its training and its aptitude without greatly increasing the dexterity of the right.

"There seems to be no good reason why righthanded people should not attain some of the ambidexterity which is usually the privilege only of the lefthanded. A little trouble expended in practicing with the left hand, as well as the right, throwing, drawing, and other common movements requiring skill, would be rewarded by a much increased usefulness of that generally neglected member. If there is a natural preference for the right hand, it is probable that no amount of practice would make the left equally expert in actions that have once been well acquired by the right. But the experience of the lefthanded seems to show that it is well worth while for the righthanded to give more attention to their despised left hands than they usually do."

VESUVIUS is again in eruption and visitors climb no higher than the observatory. Liquid lava is flowing from many little outlets in the crater opened last July. The appearance of the mountain is very picturesque at night.

### AN IMPROVED T-SQUARE.

The illustration represents a tool designed to be more satisfactory than the one ordinarily employed in locating points and taking distances, dispensing with the ordinary ruling and measuring separately with a T-square and scale, the latter being adjustably placed in the arm of the square, so that any given distance can be laid off, beginning at any point on the paper. The improvement has been patented by Morgan J. Hammers and Charles R. Clark, of Champaign, Ill.




HAMMERS & CLARK'S T-SQUARE.

At the working side of the blade of the square is an edge of transparent material, under which, in a longitudinal channel, is movable a strip of steel marked off in inches for the greater portion of its length, the inner end portion only being marked for the fractions of an inch, and this portion coming under an elongated opening in the transparent edge. At each side of the center of the elongated opening is a pointer, and the scale is movable endwise in its transparent sheath by an angled lever fulcrumed in a chamber of the head, a short arm of the lever being pivotally connected with the scale, while its longer arm has a knob extending through a curved slot in the upper face of the head. The square is placed on the paper to mark off the required number of inches, and the knob is moved to carry the scale outward for any required fraction of an inch, as indicated by one of the pointers.

### THE BALDWIN ADJUSTABLE CYCLE CHAIN.

The modern bicycle is the product of two main factors, the chain gearing and the pneumatic tire. Any defect or trouble in these parts tells heavily against it. Above all, the chain is the source of trouble, on account of wearing at the joints, technically though incorrectly called "stretching." As the rivets wear, the chain becomes too long and out of pitch with the sprocket wheels. Profuse lubrication may keep it going, but it never works properly after this wear has declared itself. It would seem easy to prevent, in great measure, the trouble, by hardening the links and rivets. But if the rivets are made of hard steel, they cannot be headed, and if of soft steel, they wear. To illustrate the effects of "stretching," Figs. 1 and 2 of the cut may be referred to, the first showing a chain in pitch, the second one which has stretched out of pitch.

These figures have another interest of their own. They were drawn from a Baldwin chain which had been used on a bicycle for 6,000 miles, and the stretch shown in Fig. 2 was removed by the simplest possible manipulation, and the chain was brought into the condition shown in Fig. 1 in a few minutes by the rider himself.

The peculiarities of the chain we describe affect its construction and adjustability. It contains no more than the normal number of parts, and in the omission of the usual bolt and nut for connecting the ends, the parts have even been reduced in number.

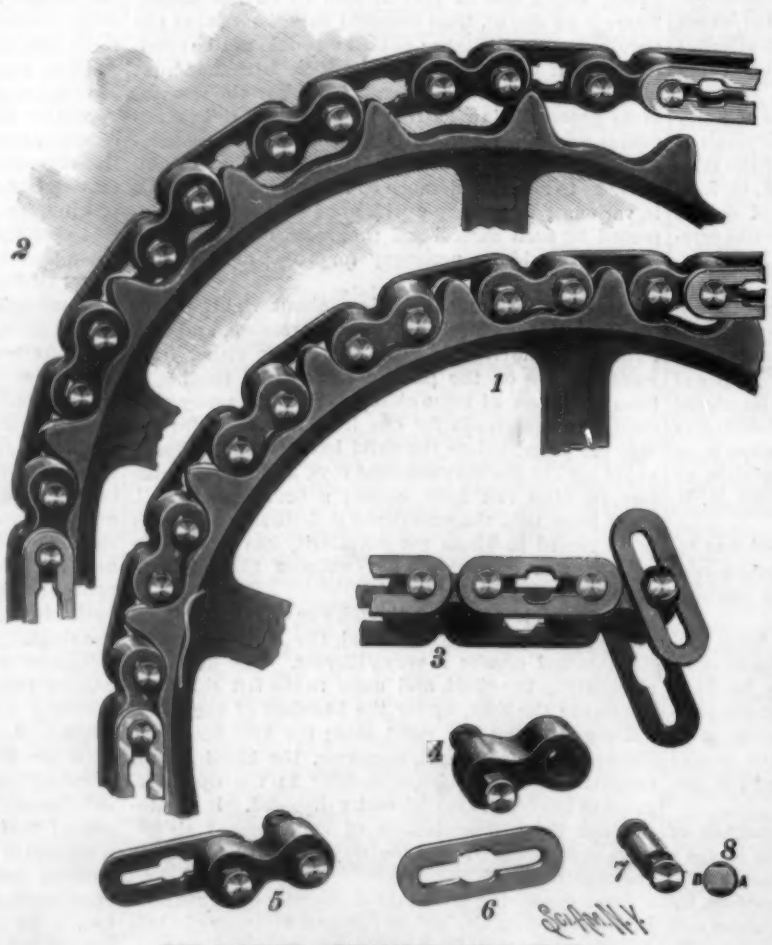
The pins are secured in place without riveting. Each pin is turned and worked into its completed shape by machinery, and is hardened. No further operation is required, as its shape is such that, once in place, it stays there and is prevented absolutely from rotating in the side plates. Figs. 7 and 8 show the pin. It is originally cylindrical, but is slotted out a short distance from each end, so as to form a neck. This neck is cut in from three sides of a square only, as shown in Fig. 8, one side being left intact; the side, A, of the neck opposite the untouched part, B, being rounded. The pin is next hardened and is ready for the chain.

The side plates are shaped as shown in Fig. 6. The central enlargement of the slot is large enough to let the pin pass through. Owing to the diminished area of the pin at the neck, this portion can slide into the long slots of the side plate.

The block of the chain shown in Fig. 4, with one pin inserted, needs no explanation, as it is of the usual type. Fig. 5 shows one block and one side plate with the pin in the slot of a side plate, and Fig. 3 shows the chain still further assembled. The system is obvious. The pin is thrust through the central portions of the slots in the side plates and through one of the apertures in the block. It is turned so as to bring the side, A, Fig. 8, toward the ends of the side plates, and is then slid into the slot. The heads or flanges of the pins hold them securely in place, and the parallel sides of the neck prevent any rotation in the side plates.

If it went no further than this, the chain would be an improvement of no low order, because, the parts being interchangeable, if the chain breaks on the road, the rider is able with the simplest tools to replace the broken link with parts from an extra link carried in the saddle bag. But its adjusting quality is still more striking. By sliding one of the pins back to the center of the side plate and rotating it through half a circle, the portion, B, is brought to the front in place of A, and the link is shortened by the depth of the slot at A. It is clear that, as the pins are drawn, this would be an excessive amount for almost any case, and that it would be very troublesome to so treat every pin. To prevent this trouble the slot is made of the depth shown, the pins being cut out $\frac{1}{16}$ inch deep at A, so that turning all the pins in a 52 inch chain would reduce its length a little over three inches. To adjust it after stretching, a few pins only are turned at regular intervals. Thus to take up $\frac{1}{16}$ inch of stretch, every sixth pin is turned, a total of 17 pins giving an adjustment of $\frac{1}{16}$ inch. This overcorrects every third link, and the overcorrection is distributed between three links, so as to be practically imperceptible.

Owing to the practicability of hardening the pins, this chain will outwear two ordinary ones. With adjustment, it should, on this basis, outwear twelve or more. This chain is being manufactured by the Baldwin Adjustable Cycle Chain Company, No. 4 Walnut Street, Worcester, Mass.



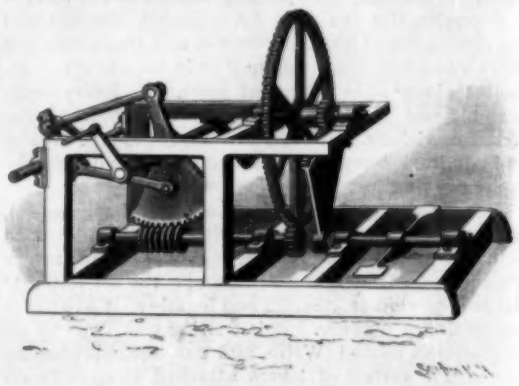

THE BALDWIN ADJUSTABLE CYCLE CHAIN.

### The World's Merchant Navy.

The annual statistics of the Bureau Veritas relating to the mercantile navy of the world give the total number of sailing vessels now afloat measuring over 50 tons as 25,570, with an aggregate tonnage of 9,323,995 tons. Of this number Great Britain comes first with 8,793 ships of 3,333,607 tons. The United States is second with 3,824 vessels and 1,362,317 tons. Norway is third, with nearly 1,000 less vessels than the United States, but nearly the same amount of tonnage. France occupies only the eighth rank, between Sweden and Greece. In regard to the steamers: England counts 5,771 vessels with nearly 10,000,000 tons. Germany, which comes second, has 826 steamers of 1,306,771 tons, France third, with 501 steamers and 864,598 tons, while the United States holds fourth place with 447 steamers and 708,399 tons.

### A NOVEL MECHANICAL MOTOR.

The illustration represents a motor which may be conveniently operated by foot power to convert reciprocating into rotary motion, and to multiply the movement, to drive machinery of various kinds. It has been patented by James M. Dickson, Roseneath, Miss. In a frame of suitable strength and form, two treadle levers are alternately depressed to rock a shaft carrying a segment rack meshing with a pinion on a short shaft which also carries a large gear wheel. The latter meshes at its lower side with a pinion on a shaft carrying a screw or worm meshing with a spirally



DICKSON'S MOTOR.

toothed segment gear journaled on a transverse shaft, and extending from this segment is an arm to which is pivoted a connecting rod whose opposite end is coupled to a crank in the power shaft. A second connecting rod pivoted to the segment is coupled to a second crank in the shaft, set opposite or quartering to the first crank. By operating the treadles a continuous rotary movement is thus given to the power shaft, and the motor is especially well adapted for use in cases where it is essential that the hands be otherwise employed.

### Guarding Against Moths.

Moths deposit their eggs in the spring, and this, therefore, is the proper time to take precautions against their ravages among goods which contain wool. It is not the moth, but the moth maggot, that does the mischief. The moths fly through the house in April and continue sometimes as late as August, seeking places in which to lay eggs. There are from a dozen to about seventy-five of these eggs in each nest, which hatch after a little while into small white worms. These worms devote their lives to eating the material in which they find themselves. As to remedies, almost every one has something to recommend, but all of the remedies are of but little account after the moth egg has been laid. There are things like cedar, camphor, and tobacco, the odor of which is disagreeable to the moth, and when the female is looking for a place to deposit her eggs, she may be deterred from laying them near these substances, but if the eggs are really laid, the grub will pursue its destructive work without paying any attention to the odors, and would do so were the smell many times more pungent. The principal attention should therefore be given to keeping the moths out.

If goods are in stock and likely to remain, some of them, at least, through the summer, better thoroughly beat them with a thin rattan and air them for several days in the sun. Nothing displeases moths so much as sunlight, direct or even indirect. Then wrap them up in newspaper; wrap perfectly tight and paste the ends so that no openings remain for the insects to get through. They cannot eat through paper. Examine at least once a month, to make sure of it, and beat and air. Furriers have no other secret than this for keeping furs. For clothing the garments should be thoroughly beaten in order to be certain that no eggs are in them, and then they should be sealed up in paper boxes or bags. Such boxes may easily be procured in any large town or city, an excellent pattern being the boxes used by tailors for delivering garments. The crevices where the cover fits on should be made tight by the use of strips of gummed paper, also a commercial article, and one may feel assured that no damage will be possible. Paper bags are also sure, but they should be sealed at the top.

### A DURABLE BICYCLE TIRE.

The illustration represents a bicycle tire which will not be readily punctured, and which will not collapse when punctured. It has been patented by Dr. Emil Christiansen, of Leavenworth, Kansas. The tire is of the hose pipe pattern, preferably of rubber or a combination of rubber and fabric, and has a valve for its inflation, of any approved construction. The tire is much thicker at its tread than at its side and inner surface, such increased thickness forming a cushion preventing the puncturing of the tire by tacks, pieces of glass, etc. On the inner surface of the tire are lugs,

CHRISTIANSEN'S PNEUMATIC TIRE.

preferably made of rubber, and the lugs are connected by springs of such length that, should the air escape from the tire, the springs would hold it distended and enable the tire to be used when not inflated almost as well as when inflated.

### The Electrical Conductivity of Aluminum.

In an article appearing in the London Electrical Review, Mr. G. L. Addenbrooke announces that, according to researches of Lord Kelvin, the conductivity of pure aluminum is 68·5 per cent of that of pure copper. The usual conductivity, as given in the books, hitherto has been 56 per cent that of copper. Lord Kelvin's research has, therefore, raised this by 21 per cent, so that the conductivity of a wire of pure aluminum of the same section, instead of being a little over a half that of a copper wire of similar section, is more than two-thirds the conductivity. Consequently, the diameter of an aluminum wire of the same conductivity as a given copper wire will be only 15 per cent greater or less than one-sixth greater than that of the copper wire. This is a small fraction, and it is evident that for such a small increase of diameter the extra cost of insulating aluminum conductors to the same thickness as copper ones, and to secure the same conductivity, will present no serious obstacle.

Looked at in another light, copper is about 3·3 times the weight of aluminum; on Lord Kelvin's figures the conductivity of wire of equal weights of copper and aluminum will therefore be as 100:22·6, so that the weight of an aluminum wire of the same conductivity as a copper one would be four-ninths of the latter, or considerably less than one-half.

It would be difficult to say what extra cost would be entailed in manufacturing aluminum of this purity, but it may be assumed that before long the resources of metallurgy will be equal to it at a moderate cost.

As aluminum is just as pliable and easy to work as copper, it goes without saying what an advantage it would be in constructing heavy cables, and how much less strain on the insulating material it would impose. For overhead conductors for the supply of power the advantages of obtaining a conductor of equal conductivity, with a trifling increase in diameter and of half the weight, are also manifest.

As a conductor, aluminum is now about twice as costly as copper; but as by the electrolytic process the price has already been reduced in eight years from 90 cents per ounce to 35 cents per pound, it is abundantly clear that, with the inevitable improvements which are taking place, the difference in price between aluminum and copper, which still exists, will be more than obliterated before long.

### Unsafe Petroleum Lamps.

Starting out with the impression that something should be done to put a stop to the loss of life and the fires caused by "lamp accidents," the London Lancet has been experimenting with a number of lamps—almost all of the cheap sorts—purchased at shops in the poorer districts of London. Even the cheap oils were found to be reasonably safe and were found to pass the flashing test of 73 degrees. Out of the whole number of twenty-two lamps which were tried, two only were probably safe, and of the rest six were "very dangerous," nine "dangerous," and five "uncertain." It was found very difficult—almost impossible, indeed—to cause even the cheapest of these lamps to explode, although efforts were made to bring about the result. Even when the temperature of the oil and reservoir was 100 degrees, blowing down the chimney simply extinguished the flame. Generally speaking, the conclusion is that a great majority of accidents arise from the faulty construction of the lamps.

The reservoir should be of metal or non-fragile material. It should be fixed firmly in the base, and not rest loosely, as is the case with many beautiful and artistic lamps, in a cup-shaped stand.

The lamp should have a base heavy enough to minimize the risk of upsetting.

The burner should be connected to the reservoir by a screw with well cut thread, requiring at least three entire turns before it becomes detached from the reservoir. It should be made tight to the reservoir by means of a washer. Bayonet joints, or pin and slot joints, not to say the mere fitting on of the burner like a cap on the mouth of a reservoir, should be prohibited.

The wicks should be constructed of material of good quality, and should fill the space of the wick tube. The wick should be replaced by a new one as it gets worn and diminishes in size. Circular wick tubes should never be fed by a flat wick, the edges of which are not likely to close up in the wick tube. The wick in these cases should be a complete cylinder.

The wick tube should be made to descend in the reservoir within at least a quarter of an inch of the bottom. Assuming the screw of the burner to be free from defect, it would be impossible for oil then to escape—the source of most of the danger of lamps, nearly all of which have their wicks hanging unguarded in the reservoir. This arrangement would also render it impossible for flame to travel into the reservoir space.

### SKIRT PROTECTING SCREEN FOR BICYCLES.

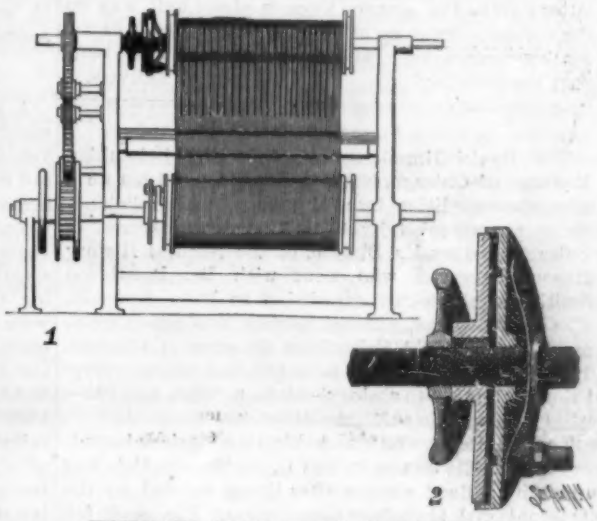
The illustration represents a folding screen attached to the front end or head of a lady's bicycle, there being a screen at each side of the head, adapted to be folded up against it or unfolded and extended past the pedals, to protect the feet and ankles from view when mounting or riding, and to prevent the skirts from being blown about the limbs. The improvement has been patented by Theron R. Cherry, of Buckhannon, West Va. The folding, fanlike screens are secured by suitable clips or brackets to each side of the head, the

CHERRY'S SCREEN FOR LADIES' BICYCLES.

rods of which each screen is composed being covered by any suitable fabric and pivoted together at their lower curved ends, while extending down upon the forward arm of each screen there may be, if preferred, a light leather casing into which the screen may be folded and held in compactly folded position by cords or straps. The curvature of the arms causes the screens to extend outwardly a sufficient distance to avoid the pedals and not interfere with their operation by the feet of the rider. The invention also provides for a front screen, not shown, slotted to straddle the front wheel, and close the space and prevent draught between the side screens.

### A WARP SIZING MACHINE ATTACHMENT.

The illustration represents an attachment to the ordinary slasher, to enable the operator to size and put on the beam a small number of ends—or large, if required—but particularly for double beam work, where the double or top beam only requires a small




WOODMAN'S WARP SIZING IMPROVEMENT.

number of ends, the same to be done at one operation, and at the same time that the regular warp threads are being sized which are to constitute the main body of the fabric. The attachment has been patented by Alvin Woodman, No. 32 Wilder Street, Brockton, Mass. This attachment is for supporting and operating an auxiliary beam on a slasher on which a portion of the warp threads are to be wound, having a fixed spindle on one side and a rotating spindle at the other, driven by gears in connection with draught roll gear of slasher. The latter spindle being provided with a fixed and a loose disk, the latter having the usual stud or pin for driving the auxiliary beam, and the speed being regulated by frictional contact between the two disks. This contact can be so finely adjusted that just the exact amount of tension and speed required can at all times be maintained for either a large or small number of ends. Fig. 1 shows arrangement of gearing and Fig. 2 section of friction disks, with spring and hand wheel regulating nut. The concentric rib on one disk and a groove on the other are for properly holding in place either a large or small friction pad, for either a large or small number of ends. By this improvement, therefore, after sizing and passing over the drying cylinders all the threads required for both the regular and special weave, they are separated at the measuring roll, and wound on separate beams at one operation. This machine has been in very successful operation for more than one year.

### Fine Crushing and the Leaching Process of Gold Extraction.

In the earlier days of gold mining, when the common method of recovering the gold was by the use of the amalgamated plate, the stamp battery was used almost exclusively for reducing the ore to pulp of the desired fineness. With the introduction of the leaching process came the demand for finer crushing, and a more perfect separation of the precious metal from its inclosing material, so that the chemicals might penetrate the pulp with a more searching effect. The demand has brought out various forms of crushing machinery, and some of the mills have shown remarkable results, both in capacity and in the fineness of the crushing.

An interesting test of the comparative efficiency of the new methods of crushing was recently had at Nevada, where the rock is of the hardest kind, and has proved very destructive to most forms of pulverizers. Pulp from a Griffin mill, with a capacity of 25 tons of rock a day, showed on an average of from 89 cents to $1.65 per ton in the tailings. The test was made by Capt. J. R. De Lamar, of New York City, and, as a result of the experiment, he is adding a dozen of these mills to the plant.

### Chrysoprase in California.

A rich vein of chrysoprase, a rare variety of chalcedony of great value, has been discovered in Tulare County, Cal., by Curator Wilcomb, of the Park Museum. Chrysoprase in its perfect state has been found in limited quantities in lower Silesia, California, and Oregon, and an inferior grade is found in Vermont; but the present find of chrysoprase is of the finest quality, and the gems when cut command a high price.

## Correspondence.

### The April Stars.

To the Editor of the SCIENTIFIC AMERICAN:

A correspondent calls attention to a singular, and to me unaccountable, slip of the pen in my article on "The April Sky," in the SCIENTIFIC AMERICAN for April 11. As printed, the statement reads that Spica, the chief star in Virgo, is to be seen shining between Arcturus and Vega. In fact, it is Arcturus which is between, although not exactly in a line with, Vega and Spica. When Arcturus is on the meridian at midnight in the latter part of the month, Vega is about half way up the northeastern slope of the sky, while Spica is in the southwestern quarter, about three-quarters of an hour past the meridian. GARRETT P. SERVISS.

### Science Notes.

Prof. Daniel Giraude Elliott, of the Field Columbian Museum, of Chicago, has left London for Aden on a scientific expedition into Somaliland and Gallaland. He is accompanied by Carl Akeley, taxidermist, of Chicago, and by Mr. Dodson, of the Natural History Museum, London, who went with Dr. Donaldson Smith on his recent expedition to Lake Rudolph. The object of Prof. Elliott's journey is to collect specimens for the Field Columbian Museum, of Chicago. Mammals chiefly will be collected, but almost everything pertaining to zoology—birds, reptiles, and fish—will be brought back.

The granite monument marking the Mexican boundary line, at Tia Juana, in San Diego County, Cal., was upset by a flood shortly after it was erected by the International Boundary Commission. The shaft fell into quicksand and efforts to recover it were unsuccessful. It has been necessary to buy a new site for another monument.

In the Minnesota Botanical Studies for 1895 (the organ of the Geological and Natural History Survey of Minnesota), Mr. Roy W. Squires has an interesting note on the result of a series of experiments on the temperature of a trunk of Acer negundo between January and June. He states that as a general result the temperature of the tree is lower than that of the air in the morning and at noon, while it is higher in the evening. The mean temperature of the tree, as compared with that of the air, was 1·31° C. higher in January, nearly the same in February, nearly 1° lower in March, 0·85° higher in April, and 1·18° lower in May.

The Æolian harp has been put to a scientific use. Prof. Carl Barus has shown that the sound made by the wind whistling across a fine wire varied with the velocity of the wind. He showed that the velocity of the wind could be computed from the pitch of the note observed in the case of a given diameter of wire and for a given temperature of the air. With the aid of special microphonic attachments, the sounds could be conveyed through a distance so as to be isolated from the other noises at the place of exposure. By the use of a number of wires the direction of the wind could be determined.

In 1886 Hoffman determined the presence of the bacilli of tuberculosis on the bodies of flies collected in the room occupied by a consumptive. Six years later, a physician of Switzerland, Dr. A. Coppen-Jones, proved that infection can be, and actually is, carried not only by the bodies of flies, but also by their feet. Flies which have been infected with the bacilli were permitted to walk across the surface of sterilized potatoes. In two days' time numerous colonies of the bacillus prodigiosus made their appearance.

Spain has seen the necessity for reafforesting her mountains. In order to foster tree planting, the little king recently went to a village a few miles from Madrid and planted a sapling, after which two thousand Madrid school children each planted a tree. Medals were distributed among them with the inscription: "First Arbor Day instituted in the reign of Alfonso XIII, 1896." A similar festival is to be held yearly in different places.

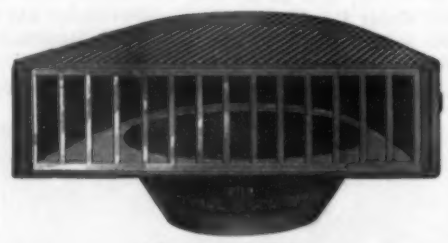
At the observatory of the Pic du Midi, the zodiacal light is always visible on clear moonless nights, and E. Marchand has, says Knowledge, during the last three years, made careful observations upon it. It is not confined to a fusiform region in the neighborhood of the sun, but continues that region right across the sky as a faintly luminous track, always dimmer than the Milky Way at its dimmest. The cosmic matter surrounding the sun extends far beyond the earth's orbit in a very much flattened ellipsoid, but is especially condensed in the neighborhood of the sun, and forms there the more brightly luminous fusiform zodiacal light as usually seen in the morning or evening.

The results of the Plankton expeditionary investigations, as stated, prove that ocean germ life, capable of reproduction, exists everywhere, except at the greatest ocean depths, being more prolific in the Canary, Florida, and Labrador waters than in the north or south equatorial currents. According to this account, bacterial life has been found at depths of 1,300 to 3,500 feet, and, curiously enough, the major portion is of those species requiring oxygen for their existence, a great number of which are also phosphorescent. M. Delebecque is quoted as having found that, in lakes, the quantity of magnesia is constant at all depths and in all seasons, the supply being derived from the abrasion of the beds of rivers draining into inland lakes; during the summer season micro-organisms are met with in abundance at great depths, whereas they are present only in small numbers at or near the surface. The researches by M. Boutan are also mentioned, the fact transpiring that photographs of animal and vegetable life were obtained by him at considerable depths, the great value of these photographs consisting in the fact that living organisms found in deep waters cannot be brought to the surface for examination without a complete change taking place in their characteristics.

### AN IMPROVED SEWER INLET.

A catch basin or sewer inlet that is very strongly constructed, that it may not be injured by a heavy vehicle passing over it, and the cover of which may not readily be removed by children, is shown in the accompanying illustration. It has been patented by George A. Ensign, and is being introduced by the Defiance Machine Works, Defiance, Ohio. A substantially conical collar surrounds the bottom opening, that it may be coupled in any approved manner with a sewer pipe, and a horizontal flange is made integral with or attached to the rear portion of the casing to facilitate firmly anchoring it in place. The front open portion of the casing has a depression adapted to receive the lower web of a grating, there being in each end of the grating a vertical groove in which fits a vertical flange on the inner face of the casing. At the rear of the casing, near the top, is a step and flange adapted to engage a rearwardly

CORNER INLET.



STRAIGHT-CURB INLET.

ENSIGN'S SEWER INLET.

extending tongue on the under face of the cover, lips at each side of the cover similarly engaging projections of the casing.

### Stokehold Temperatures in Ships.

The following is an extract from the official report of the Surgeon-General, United States Navy, referring to the state of things which frequently exists. On the cruiser Cincinnati, for instance, he remarks: "Temperatures are recorded from 90° to 170° Fah. Tentative efforts made in November to improve the system, particularly the blowers in fire rooms, have not succeeded in ameliorating the heat now common in those places. I have myself recorded fire room temperatures as high as 168° Fah. In the engine room lower platform the average is about 102°; on the upper platform it frequently reaches 135°. By the present system of forced ventilation for the engine department very little air above the rail is taken. Air is mainly taken through the spardeck hatches; also in part from the after-berth deck, and from beneath the deck near the large engine room hatch. Blowers in the condenser room force air to the engine room proper, and those above the upper platform of the engine room pass the air to the fire rooms. When under way a wind sail sends an additional supply of fresh outside air to the condenser room. The supply gotten above the upper platform in the engine room, in addition to its warmth, is also somewhat contaminated by contact with metal and oily surfaces. The blowers in the forward fire rooms do not properly function at present, and are said to be useless. Their supply is through broad louvres under the pilot house. The six fire room ventilators extending well above deck houses are 20 in. in diameter, and it is through them the fire rooms get their main supply of fresh air. The condenser room blowers ventilate the main engine room. Unless these excessive heat conditions in the fire rooms, contiguous passages, and intricate coal bunkers are remedied, it cannot be expected that the men will long endure continuous labor there. It is physically impossible for the class of men enlisted for this purpose in our navy to undergo the strain of these unfortunate conditions. Though the ship has had as yet no severe or continuous steaming, the firemen constantly apply for relief from symptoms of heat irritation, such as muscular cramps, disordered heart action, nausea, head pains, and weakness."

### The Influence of Tea, Coffee and Cocoa on Digestion.

Dr. James W. Fraser, in a recent number of the Journal of Anatomy and Physiology, has recorded the results of an interesting series of experiments on the action of our common beverages on stomachic and intestinal digestion. The experiments, says the Lancet, have been most carefully arranged from a physical standpoint, and give us some valuable hints on the digestion of the chief alimentary principles, but they have no bearing, it should be mentioned, on individual variations of human digestion, or on the influence of the various glands in preparing the gastric or intestinal juices. They are, however, of much value in showing how standard preparations of the peptic and pancreatic ferments are modified in action when our ordinary daily beverages are allowed their free action on the digestion of various articles of food. The digestive processes were carefully investigated, and absorption was imitated by a proper dialyzing arrangement. An artificial peptic juice, and afterward an artificial pancreatic juice, were employed, and the amount of nitrogenous matter dialyzed was most carefully estimated. The food stuffs experimented on were raw and cooked serum and egg albumens, raw and cooked myosin, syntonin, alkali albumen, casein, gluten, starch and oleine. The results obtained from an exhaustive series of experiments and analyses show that all the three typical infused beverages—tea, coffee and cocoa—retard the digestion and absorption of all the nitrogenized proximate principles of dietetic substances when peptic and pancreatic digestion are taken together, and that they uniformly retard peptic digestion, although tea may assist the diffusion of peptones from the stomach. Pancreatic digestion is also uniformly retarded, and diffusion thereafter is but rarely assisted, so that neither of them compares advantageously with water as a standard beverage for experimental investigations. A summary of dietetic advice is added to Dr. Fraser's observations, which will, in the main, agree with that which is now given by our best authorities in cases of dyspepsia; and we are glad that experimental inquiries afford so strong a basis of support to empirical clinical observations:

"1. That it is better not to eat most albuminoid food stuffs at the same time as infused beverages are taken, for it has been shown that their digestion will in most cases be retarded, though there are possibly exceptions. Absorption may be rendered more rapid, but there is a loss of nutritive substance. On the other hand, the digestion of starchy food appears to be assisted by tea or coffee; and gluten, the albuminoid of flour, has been seen to be the principle least retarded in digestion by tea, and it only comes third with cocoa, while coffee has apparently a much greater retarding action on it. From this it appears that bread is the natural accompaniment of tea and cocoa when used as the beverages at a meal. Perhaps the action of coffee is the reason why, in this country, it is usually drunk alone or at breakfast, a meal which consists much of meat, and of meats (eggs and salt meats) which are not much retarded in digestion by coffee. 2. That eggs are the best form of animal food to be taken along with infused beverages, and that apparently they are best lightly boiled if tea, hard boiled if coffee or cocoa, is the beverage. 3. That the casein of the milk and cream taken with the beverages is probably absorbed in a large degree from the stomach. 4. That the butter used with bread undergoes digestion more slowly in presence of tea, but more quickly in presence of coffee or cocoa; that is, if the fats of butter are influenced in a similar way to oleine. 5. That the use of coffee or cocoa as excipients for cod liver oil, etc., appears not only to depend on their pronounced tastes, but also on their action in assisting the digestion of fats."

### Tenacity of Life in Insects.

Mr. J. C. Warburg writes to the Entomologist: "When I was still new to collecting in South France, I discovered one day, to my great joy, a large female of Saturnia pyri hidden away in some bushes. The specimen was the first I had ever caught, and I decided, on account of its large body, to stuff it (a quite unnecessary operation; I have kept dozens since unstuffed). The moth was first apparently killed by being forced into a cyanide bottle, where it was left about an hour. The abdomen was then emptied and the cavity filled with cotton-wool soaked in a saturated solution of mercuric chloride. The insect, pinned and set, was discovered next day attempting to fly away from the setting board."

SOME Syrian tobacco has so small a percentage of nicotine that this alkaloid can hardly be detected.

### THE HOLLAND SUBMARINE TORPEDO BOAT.

The idea of a submarine vessel for purposes of attack originated long before the time the SCIENTIFIC AMERICAN was founded. In the days of the revolution David Bushnell built one near Peekskill. His old barn, which was still standing some years ago, was the last reminder of his futile attempt. Robert Fulton bent his energies in the same direction and exhibited to Napoleon, in the harbor of Brest, a boat which, sailing on the surface, could be submerged and could be propelled under water for a long time. Napoleon put an old hulk at his disposition, which was successfully destroyed by submarine attack, but as the speed under water was only two knots an hour, the emperor failed to avail himself of the invention. Bushnell's was in actual service, and nearly destroyed, in 1776, the British sixty-four gun ship Eagle. Sergt. Ezra Lee, who was alone on the submarine boat, would probably have been successful in his attempt to sink the vessel, but was unable to successfully attach his torpedo to the bottom of the ship.

In our present issue we illustrate a boat now under construction by contract for the United States government which will go far to show the value of this means of attack. Mr. J. P. Holland, an adopted citizen of the United States and a native of Ireland, for nearly twenty years has been working on this subject—submarine navigation—and has built three boats, the first of which was begun in 1877. Ten years later he proved his plan to be so far practical as to be able to interest the naval department, which issued a circular to inventors calling for designs. Meanwhile in foreign countries other submarine boats were being tried, none of them seeming to prove entirely successful, or at least not succeeding in winning the desired confidence of the naval authorities. But at last in the present boat we have a bona fide war vessel being built under contract for the United States government, and one which it is hard to believe will not be a valuable auxiliary to the navy.

The Holland vessel is of cigar shape, with frames 3½×3½ inches, weighing 12 pounds to the foot. Her outside plating is ⅛ inch thick, tapering to ⅜ inch at the extreme ends of the vessel; for a portion of her length she is double skinned. She is propelled by triple expansion engines actuating triple screws as long as the smoke stack is above the surface; and for her diving operations, when the smoke stack has to be completely housed, the residual pressure of the steam will be used for her propulsion, water heated under pressure evolving steam for a long time. Then, when this fails, she will have her storage batteries and electric motors to operate the propellers.

Three stages of flotation are provided for; in her light condition with the hull well above the water she is to make 13½ knots per hour; her next stage is that termed the "awash" condition. For this the body of hull is submerged, an armored superstructure, including a conning tower with 8 inch Harveyized steel plates, projecting above the surface, while, concentrically placed, the air tube and the smoke stack rise above the whole. The superstructure is carried forward and aft, and pointed at both ends to give a clean entrance and run, so as to interfere as little as possible with the speed. Her speed under these conditions is to be 12½ knots an hour. Her third stage is the submerged condition. For this the smoke stack and air tube are housed, the opening through which they projected is hermetically closed, and the vessel is in condition to be sunk to a depth not exceeding 45 feet, her strength of construction being sufficient to enable her to resist the pressure of the water at this depth. She still has flotation, there being a margin of 375 pounds of buoyancy in her favor, the submersion being obtained by special devices. Submerged she is to make 6½ knots per hour.

The submersion is to be effected in two ways. At her stern she carries horizontal rudders. If the vessel in moving, by inclining these rudders the bow is caused to pitch downward and the vessel runs down an inclined plane determined by her axis, the inclined plane really representing the resultant of her buoyancy as a vertical upward component and her inclination of axis as a downward acting component. This diving action is similar to that used in the old Tuck submarine boat Peacemaker, which has been several times described in our columns. But the vessel is also to be able to dive from a state of rest. To secure this power she carries at her bow and stern two screws with vertical axes actuated by electric motors. By working these screws in one or the other direction, at varying rapidity, the vessel can be sunk rapidly, can be maintained at any desired level, can be rapidly drawn upward to the surface, or its approach to the surface can be made as slow as desired.

It having at last been settled that ocular navigation is impracticable under water, a tube is provided to be raised above the surface when the vessel is submerged, which tube is to carry an inclined mirror or prism, camera lucida fashion, by which the commander will be able to watch the enemy and guide his course. In the restricted volume of the boat a compass cannot be used, owing to the proximity of so much iron and steel. An attempt is to be made to hold her mechanically in a straight course by a triangular drag. The theory of this is that she should be started on a proper course by ocular methods, with the drag set astern of her when on such course, any inclination from the desired direction causing the drag to pull to one side or the other, actuating the rudder so as to bring her back to her original course.

She is to carry five automobile torpedoes, two expulsion tubes and the necessary air plant for operating them. When diving, she must be able to reach a depth of 20 feet below the surface of the water within one minute from the light condition; when awash, she must be able to dive to the same depth within 30 seconds. She has an automatic pressure diaphragm which governs her submersion so that she cannot exceed the safe depth.

The general distribution of machinery is shown in the sectional view, while the bow and stern views and side elevation are also given. Another view shows her in light condition and awash, while the submarine attack is illustrated in another cut.

The air supply is primarily obtained from reservoirs where it is stored under 2,000 lb. pressure. Moreover, a float with air tube is provided which can be allowed to ascend to the surface, when air can be pumped down through the tube into the hull.

The following are the dimensions:

| | | |
|---|---|---|
| Length | 80 | feet. |
| Diameter | 11 | " |
| Displacement, light | 118·5 | tons. |
| " awash | 137·84 | " |
| " submerged | 138·5 | " |
| Reserve buoyancy submerged by motion or awash | 0·66 | " |
| " " " lying still | 375 | pounds. |
| Horse power of engines | 1,800 | |

Provision is to be made for the escape of the crew in case of accident. This will take the shape of buoyant diving helmets or suits, and a method of opening the hatch so as to escape if the boat remains submerged.

### The Cotton Mills of Japan.

According to a Japanese native paper, the number of spindles in the cotton mills of Japan now exceeds 1,000,000. In consequence, the supply of yarns is exceeding the demand, and some of the spinners are of opinion that it is a risky attempt to start new mills at present, as there will be caused many difficulties in the way of obtaining raw cotton and maintaining the equilibrium of supply and demand. According to the returns prepared by the Cotton Spinners' Union, Osaka, the number of spinning concerns in the union and of their spindles are as follows:

| | No. of Concerns. | No. of Spindles. |
|---|---|---|
| Actively working | 58 | 632,180 |
| Not yet opened or being established | 6 | 352,427 |
| Total | 64 | 984,737 |

Besides these are several concerns outside the union. Among them the Kyoto Spinning Company has 10,000 spindles, of which 2,000 are actively working; the Heian (10,000 spindles), the Fushimi (10,000 spindles), the Bizen (5,000 spindles), the Nishinari (15,000 spindles), the Kawachi (10,000 spindles) and the Tokwa (75,000 spindles, to be established in Shanghai), are all being established. The number of spindles throughout the conntry, active and inactive, is put at 1,119,557.—Industrial Record.

### Methods of Closing Cracks in Cast Iron.

Many methods for closing cracks or pores in cast iron have been devised, according to Industries and Iron. Chemical or other products, such as salammoniac or urine, are often used to cause the formation of an iron salt, easily oxidizable, which in a short time gives a certain quantity of hydrated oxide of iron. This is made use of very often to stop up leaks which develop in metallic cylinders. This method is, however, a somewhat lengthy one, several days being oftentimes necessary to obtain satisfactory results; that is to say, entire absence from leakage. A method of closing cracks or pores in a more rapid and certain manner has lately been devised by M. A. Demalght, of Brussels. The method is described as follows: The cylinder is filled with a certain quantity of perchloride of iron. The liquid is then compressed until globules appear on the external surface. The cylinder is then impregnated with perchloride of iron right through, as regards its thickness. Any perchloride in the cylinder is then emptied out, the cylinder being then wiped until the polished surface is again made brilliant. It is then filled with ammonia at 22 degrees Baume, this also being subjected to compression. The effect of this operation is soon noticeable, the perchloride of iron in the metal becomes transformed under the influence of the ammonia into hydrated oxide of iron, at first somewhat frothy in character, and afterward, under the influence of the external pressure, rough and compact. Some hydrochlorate of ammonia also remains, which will soon afterward react on the iron, which will eventually be converted into an oxide compound, adding itself to the first. The leaks marked at the commencement of the operation will be entirely stopped as soon as the ammonia commences to move out externally, the whole operation not occupying more than a couple of hours. One advantage of the new process is that leaks are stopped by an independent injection of hydrate of iron, while in the many processes at present in use the result is obtained at the expense of the iron in the cylinder, that is to say, one part has to lose that which another portion gains.—Railway Review.

### A Metol and Hydroquinone Developer.

Mr. John Russell says our old friend pyro is an exceedingly valuable developer, with, however, a tendency to give too dense a deposit in the high lights before the half-tones are well out; it also stains the hands and plates, giving slow printing negatives, and sometimes produces color fog. Hydroquinone, though excellent in many respects, frequently gives exaggerated contrasts, and in cold weather works so slowly as to inconveniently prolong development. For correctly exposed plates amidol works splendidly; but with full exposure fails to give printing density. Eikonogen and rodinal also, though very powerful, fail in the same direction. Metol is, perhaps, the most powerful developer we possess, and comes nearest to pyro as a density giver, its only fault being a tendency toward oversoft results.

Efforts have been made to combine developers of opposite characteristics, such as hydroquinone and eikonogen, in the hope of securing the advantages of both by neutralizing the faults of each, and the most perfect arrangement of this kind is a combination of metol and hydroquinone. These agents work remarkably well together, the tendency of hydroquinone toward undue hardness neutralizing and being neutralized by the fault of metol in the direction of oversoftness. By this combination we get a developer which keeps well, works rapidly, with perfect freedom from fog or stain, brings out all available detail with true gradation, gives good printing negatives without undue opacity, and is capable of considerable modification. It is, therefore, the nearest approach to an ideal developer, and has, after many varied trials, become my favorite. The formula I have adopted is as follows:

| | |
|---|---|
| Metol | 80 grains. |
| Hydroquinone | 45 " |
| Sodium sulphite | 640 " |
| Sodium carbonate | 640 " |
| Distilled water | 20 oz. |

The metol and hydroquinone should first be dissolved in hot water; when cold the other ingredients may be added.

Though this is a so-called single solution developer, it can be modified to suit any requirement by dilution and the employment of a 10 per cent solution of potassium bromide.

For very short exposures it should be used full strength. For normal exposures it may be diluted with an equal bulk of water, plus 1 grain of bromide per ounce. Further dilution, with still more bromide, will be necessary for overexposure. Dilution gives contrast; concentration gives power and density with reduced contrast. The same solution may be used for several plates, and development must be continued until the apparent density is much greater than is usual with pyro.

In the hands of careful workers the convenience, power, and ease of working with this combination, and its capability of giving excellent results, will always make it a favorite developer. — The Photographic News.

### Bacteria in the Treatment of Flax.

The ancient and familiar process used in the manufacture of linen, and known as the "retting" of flax, has long eluded all endeavors to place it upon a sound scientific basis. Prof. Winogradsky, of St. Petersburg, has, however, recently shown that it is directly dependent upon the action of particular bacteria. Considerable difficulty was experienced in discovering the special microbes responsible for the process, and several different varieties were isolated by means of gelatine plate culture from the retted or fermented flax; but in no case, when inoculated on to sterilized flax, did retting ensue. When, however, portions of retted flax were added to the sterilized flax, vigorous fermentation was set up in from twelve to fifteen hours. In the next series of experiments, pieces of sterilized flax were inoculated, placed in tubes containing water, the surface of which was sealed from the air by means of a film of oil. In this manner, after a long series of successive inoculations, a somewhat large, spore forming bacillus was discovered, which subsequent experiments proved to be the specific microbe responsible for the retting of flax. It was obtained in a condition of undoubted purity by anærobic cultivation on slices of potato which were rubbed over with chalk, and from these cultures the retting of sterilized flax was accomplished with the greatest ease. Prof. Winogradsky is of opinion that the so-called pectic fermentation, by which is understood the transformation during retting of insoluble pectic substances into soluble, must now be regarded as a fermentation process in the strict bacteriological sense of the word.—Nature.

### A QUADRICYCLE FIRE ENGINE.

We illustrate herewith a quadricycle fire engine that attracted considerable attention at the recent bicycle exhibition at Paris, and which presents unquestionable advantages over the hand engines in use in all places that are too small to afford the luxury of steam fire apparatus.

As shown by our engravings (Figs. 1 and 2), the engine consists of two tandem bicycles coupled by crosspieces in front and behind and having but a single steering post in front. The free space between the two frames is occupied at the front by a hose reel, in the center by a rotary pump, and at the back by a coupling that allows the pump to be put in communication with a water tap.

Fig. 1.—THE SCHOEDELIN QUADRICYCLE FIRE ENGINE.

This entire affair weighs scarcely more than 130 or 133 pounds, which represents about 33 pounds per man. It will be seen that upon such a machine four trained cyclists can reach a fire at a speed that could never be attained by fire engines drawn by horses.

As soon as the engine has reached a favorable position, the four men jump from their seats, and, while two of them adjust the couplings, a third unreels the hose, and the fourth, turning down the jointed support, raises the back of the machine and throws the pump into gear.

The four men afterward get into their saddles and pedal in situ with a mean velocity that causes the pump to discharge about 4,500 gallons an hour in the form of a stream 100 feet in length in a horizontal direction and about 75 feet upwardly. These figures are those obtained at the trials made at the Palace of Industry on the 23d of last December.

All the preparatory maneuvers require scarcely more than two or three minutes. If, on another hand, we take into consideration the fact that such machines, propelled by men with some little training, can reach a fire in a quarter or a third of the time made by ordinary hand engines, we shall realize how great an interest attaches to the use of them in country places where a fire so easily assumes the importance of a disaster by reason of the tardiness with which the first help comes. Everything, therefore, leads to the belief that this invention is destined to completely revolutionize the fire apparatus of small towns and villages.—La Vie Scientifique.

### The Boston Aeronautical Society.

The Boston Aeronautical Society was organized May 2, 1895. Prof. William H. Pickering, of Harvard Observatory, was chosen president, and Mr. Albert A. Merrill, secretary. For several months fortnightly meetings have been held, and at these meetings papers treating of aeronautical subjects have been read and discussed. The members have found these discussions decidedly instructive and helpful.

The objects of the society are to encourage experiment with aerial machines and to disseminate knowledge concerning the great problem of aerial navigation.

Preparations are being made for many interesting experiments, which will be tried at the field meetings of the society, to be held during the coming summer and autumn.

Among other things, the society has undertaken to encourage the fascinating study of scientific kite designing and the delightful sport of kite flying.

The society wishes to circulate its notices and reports from time to time, and it therefore requests all who are in any way interested in this subject, whether as experimenters, students or general readers, to place their names on file, addressing the secretary of the Boston Aeronautical Society, Box 1197, Boston, Mass. An important notice concerning money prizes to be awarded for the best kites will be ready for mailing May 1, 1896.

### How the Use of Acetylene Gas Affects Fire Insurance.

Charles A. Hexamer, secretary of the Philadelphia Fire Underwriters' Association, read at its recent special meeting the following interesting paper, an extract of which we take from the Insurance World. He says concerning acetylene: "It is a colorless gas, unaffected by ordinary changes of temperature, of a strong odor, resembling garlic. It combines with some metals, including copper and its alloys, forming acetylides, but will not combine with or corrode iron or steel. This fact is of some value to the underwriter, the question of corrosion of brass chandeliers and burners being of importance. That combinations of acetylene and copper are under certain conditions explosive need not be specially considered, since the amount of such a composition can in no case be great enough to cause any danger even should it be ignited. Mixed with air, in proper proportions, acetylene produces an explosive mixture. Acetylene gas burns with an exceedingly luminous flame of much greater candle power than the best city gas. Furnished to the consumer through underground pipes in a manner similar to the present system of city gas supply, there would be no greater risk from its use than from the use of city gas. In order to cheapen its use, however, it is proposed to supply acetylene gas to the consumer in cylinders, in a liquefied state, under a pressure variously estimated at 750 to 1,000 pounds. It is stated that a cylinder of gas four inches in diameter, four feet high, will contain enough gas in a liquefied state to supply an ordinary ten room dwelling with gas for three months. These cylinders it is proposed to connect directly with the gas pipe in a building; when empty, to be disconnected and a new cylinder substituted. It is necessary to reduce the 1,000 pounds pressure in the cylinder to a small fraction of a pound at the burners. This is done by a Pintsch valve, a rather complicated mechanism.

"Two important questions present themselves at this point: First. What would be the result if a possible fire in the building reaches the acetylene cylinder? Second. What would be the result if the reducing valve failed, and the entire gas pressure in the cylinder were suddenly thrown into the gas pipes in the building? It is stated that, while it is true that an increase of temperature involving the gas cylinder would produce increased pressure, before the pressure would cause a rupture of the cylinder (which is said to be tested to 8,000 pounds) decomposition of the acetylene gas into carbon and hydrogen would result, with no explosive effect. This result, it is claimed, has been obtained by heating a small cylinder of liquefied gas in a fire to a cherry red heat. While this may be true (and similar decomposition of gases—notably hydrogen sulphide, which in a cylinder subjected to heat deposits free sulphur and liberates hydrogen—are known), it remains to be demonstrated whether cylinders of liquefied acetylene gas can be safely heated without disastrous results, the fact being that the quantity of hydrogen liberated equals in bulk the acetylene decomposed; the danger of a rupture of the cylinder, therefore, is not eliminated by the decomposition of the acetylene. The result of failure of the reducing valve, which operates automatically, can be easily imagined: The liberating of a gas at nearly a thousand pounds pressure into gas pipes not intended to carry more than a few pounds pressure must necessarily produce disastrous results.

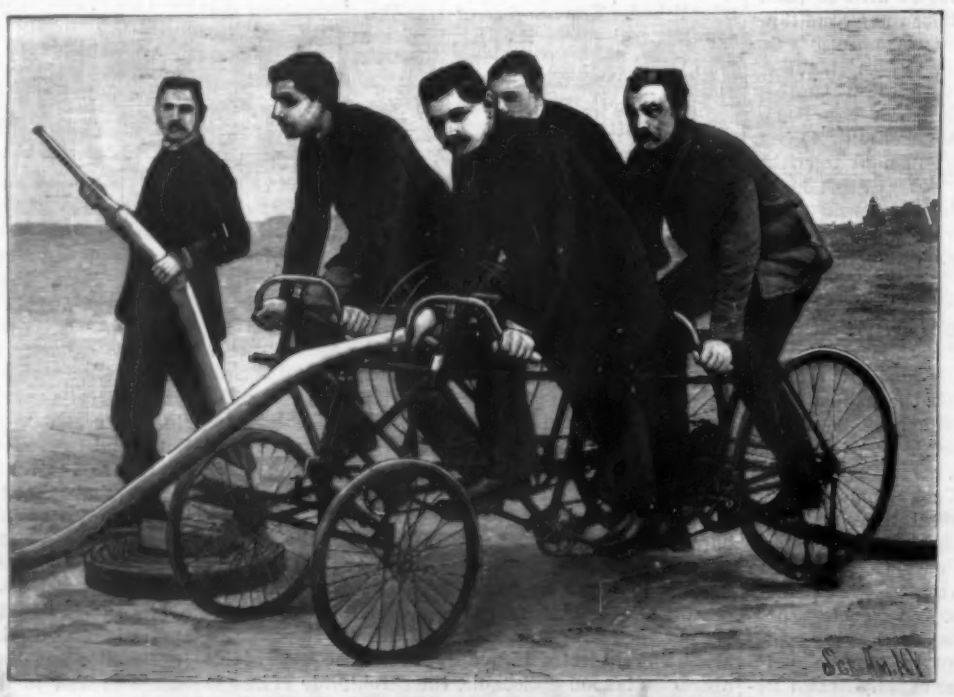


Fig. 2.—THE ENGINE READY FOR OPERATION.

"From the above it will be seen that the points of interest to the underwriter are the presence of cylinders of liquefied gas in buildings in case of fire, and possible failure of the valve intended to reduce and regulate the slight pressure of gas necessary at the burner. There is no reason why the objection from these points should not be overcome. Cylinders of compressed gas can and should be located outside the building, and a safety valve can be provided to empty the cylinder, discharging the gas into the open air outside of the building, in case the reduction fails to act.

"Besides furnishing acetylene in liquefied state under pressure, it is proposed to introduce small gas machines intended to generate acetylene directly from the calcium carbide. Apparently no special hazard attaches to this plan, provided the gas machine be located outside the building, and provided the calcium carbide be stored in a dry place and free from an accidental contact with water, which, generating the gas, might cause a fire or an explosion by coming in contact with an open light.

"It is too early to formulate rules and requirements for safe introduction of acetylene gas for illuminating purposes. The subject has hardly passed the experimental stage. The result of an accident to a cylinder of the compressed gas brought it forcibly to the attention of the underwriter. That the disaster was the result of the accidental and possibly careless breaking of a valve being experimented with cannot be allowed to modify the deduction to be drawn. As an illuminant, acetylene is so far superior to ordinary city gas that, if the claim made as to the relative cheapness of its production can be substantiated, its general introduction may be expected. A careful consideration of the subject by underwriters' associations is necessary. In the meantime underwriters are wise who carefully consider each application for the use of this new gas in its present state of development, and until proper regulations and requirements have been formulated for its safe introduction, refuse to grant permission for its use in buildings covered by their policies."

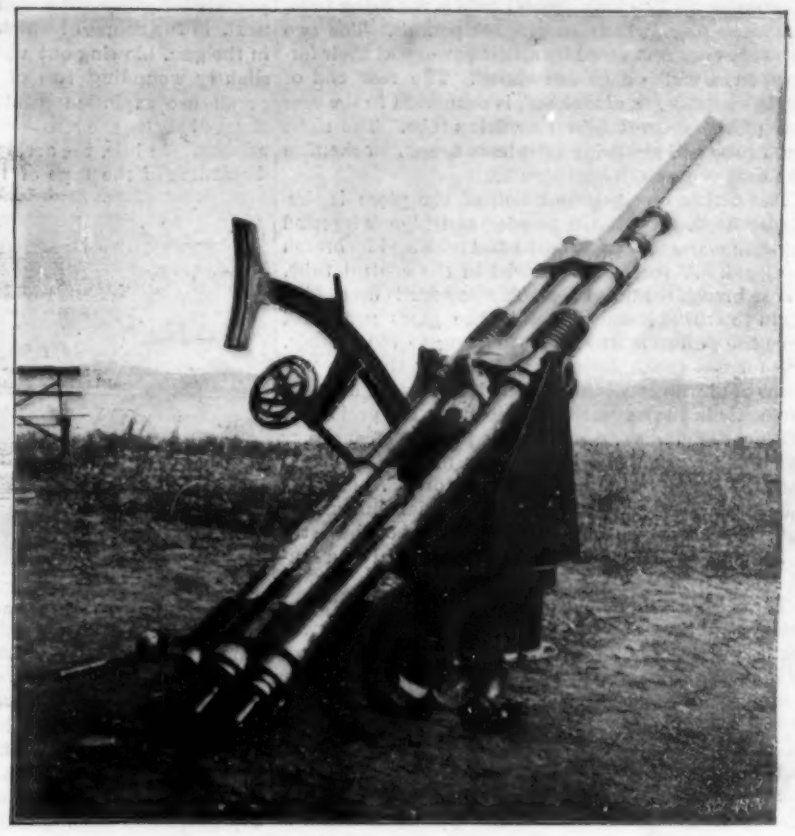
In the Japanese Imperial Budget for the current year, the sum of $21,639 has been set aside for earthquake investigation. This is a grant over and above the usual expenditure of the central observatory controlling the seismic survey of the country.

### THE DUDLEY POWDER PNEUMATIC GUN.

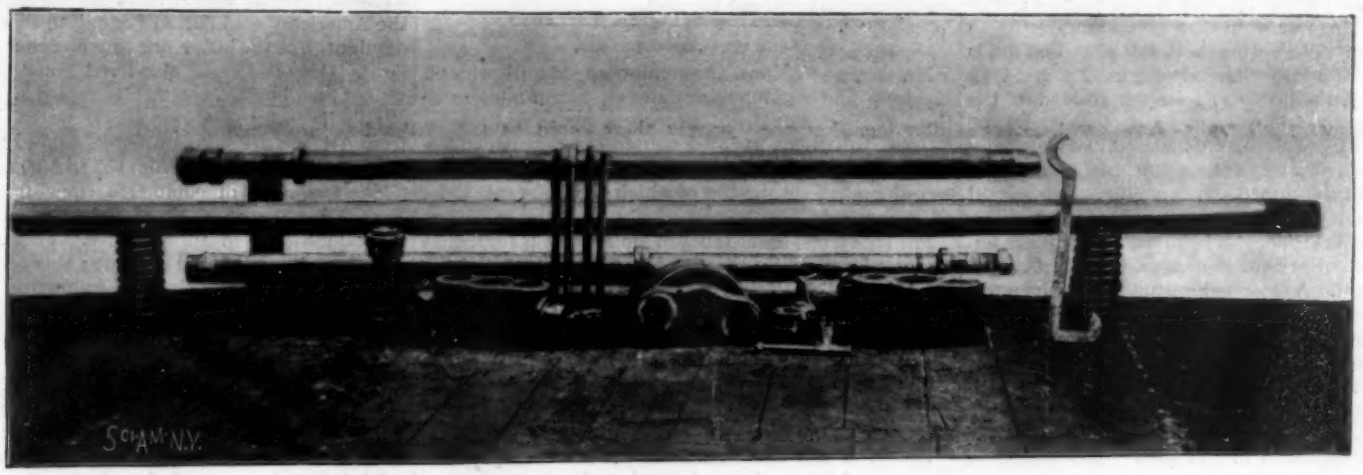
The SCIENTIFIC AMERICAN has given considerable attention in the past to the development of the pneumatic gun. A weapon adapted for aerial torpedo practice, one which could place with reasonable accuracy a torpedo containing from one to five hundred pounds of high explosive at any point within a radius of two miles, appeared destined to be a very effective weapon, especially for coast defense. The principal objection to the pneumatic gun was the extensive air-compressing plant required to operate it. The gun itself in lightness and simplicity was all that could be desired, but it was not self-contained. The Dudley powder pneumatic gun, manufactured by the Sims-Dudley Defense Company, of this city, has recently been brought to the attention of the public by a recent trial, in the course of which unfortunately a premature explosion of the shell took place. The trial was entirely successful, and the only effect of the accident was the bringing about of the abandonment of the type of fuse in use on the particular shell which exploded.

The Dudley gun operates on the pneumatic principle, but its air pressure is produced by the explosion of gunpowder, no air-compressing plant being required, so that the gun is self-contained and is a complete weapon. Two of our illustrations show various views of the gun mounted and ready for use, and one shows the parts of the gun disassembled. The heaviest

THE DUDLEY PNEUMATIC GUN—VIEW OF THE BREECH MECHANISM.



THE DUDLEY GUN AFTER THE EXPLOSION.



THE DUDLEY PNEUMATIC GUN TAKEN APART.

SIGHTING WITH THE DUDLEY PNEUMATIC GUN.

piece in a four inch gun weighs only two hundred and fifty pounds. This fact, in connection with the fewness of parts, so strikingly shown in the last named cut, gives an idea of the simplicity and practicability of the piece. The general features of its construction are these.

Three tubes constitute the principal elements. These lie parallel to each other side by side, as shown in the illustrations. The long central tube is the firing tube, and is the piece which weighs 230 pounds. The two side tubes are connected by an air passage at their forward ends, which ends are closed. The rear end of the left hand tube, also closed, is connected to the rear end of the central barrel or firing tube. The right hand tube and the firing tube have breech mechanism like that of a breech loading rifle.

The action and manipulation of the piece is simplicity itself. A metallic powder cartridge is inserted into the rear end of the right hand tube and its breech is closed. A torpedo is placed in the central tube, whose breech is then closed. The powder is fired. The air in the tubes is compressed by the gases generated from the explosion, the pressure rising to 850 pounds. The force of the explosion, cushioned by the two columns of air intervening between the powder and the projectile in the central tube, acts upon the projectile. With a slight noise and without a particle of smoke or flame the projectile is driven out of the barrel and passes smoothly through its trajectory. About the same effect is attained as with the regular pneumatic gun. The extensive air-compressing plant of the latter is, in the case of the Dudley gun, represented by a simple blank cartridge.

The recoil of the piece is comparatively slight, and springs are provided to take it up. The gun experimented with is of four inch caliber, and with its mount weighs 2000 pounds, the mount alone weighing 750 pounds. The side tubes are three inches in diameter. Over 100 rounds had been fired from it up to the day of the accident, and after all this practice there is a noticeable absence of fouling. Fifteen ounces of Dupont square scale smokeless powder form the charge. The projectiles are of the familiar type used with the original dynamite gun. The body of the shell is a brass cylinder with pointed ends. To its front is attached the fuse; from its rear a tail piece extends which carries rings or vanes set at an angle so as to insure rotation. The entire shell, tail piece and all, is 52 inches long and fully charged weighs 32 pounds. In the main body, the brass cylinder just alluded to, the charge of nitroglycerine explosive is placed. In the forward end of the charge and inclosed in a metal case there is embedded a detonating charge of guncotton. In the center of the guncotton is a cylindrical case of fulminating mercury.

The Merriam fuse operates by inertia or by direct impact. If the shell strikes the water, the inertia operates the ignition. A steel ball within it is driven forward, owing to the retardation of the motion; and the ball by striking causes the detonation of one or more percussion caps, three being used to insure firing. The ignition of a tube of slow burning powder is thus effected, which communicates with the fulminating mercury and so explodes successively the guncotton and the main explosive in the shell. The period of the explosion is determined by the slow burning powder; by altering it the time element can be regulated with the greatest accuracy.

For attack upon armor, instant detonation is required, and this is secured on the direct impact principle, by crushing in of the head, and the driving back of one to three firing pins, which ignite quick burning powder, the fulminate, the gun cotton and the main explosive in instantaneous succession.

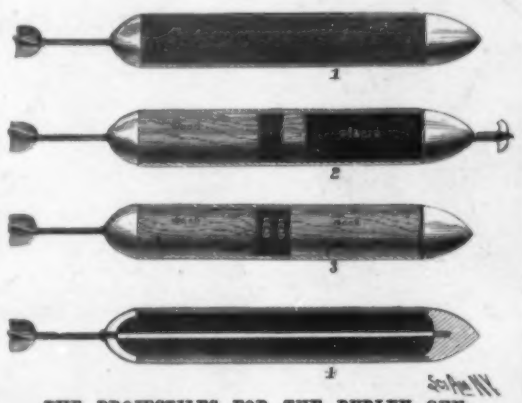
The element of safety is introduced in the Merriam fuse by a little windmill or vane on the front of the fuse. This is inclosed in a recess, whence it escapes as the shell leaves the gun, and instantly begins to turn, actuating a screw which has been screwed down upon the firing ball. After the shell has traveled a few hundred feet, the ball is free to work the instant the shell is arrested in its flight.

The shells are shown in one of the cuts. Fig. 1 shows the service shell packed with high explosive, the fuse vane being concealed within the forward cone. The rear cone is of aluminum. Fig. 2 shows a practice cone charged with gunpowder, lead ballasted, and with the fuse vane shown projecting from its forward end. It was with a shell of this type that the accident occurred. Figs. 3 and 4 are simple non-explosive practice shells, one of wood, the other of metal. The ballasting of the projectiles is of the greatest importance, as their steadiness of flight depends on the center of gravity being in a definite place.

The shell is placed in the tube without any sabot or packing, and it can be thrown about a mile and a half. The sighting mechanism operates with a level sight line, the elevation of the gun not affecting the line of sight. A fixed pressure, and consequently fixed initial velocity of about 700 feet, is employed, the range being determined by elevation. At near ranges a slight elevation with ensuing low trajectory is used.

The gun was tested at Mattinicock Point on Long Island Sound on Monday, April 13, in the presence of General Nelson A. Miles, U. S. A., and of a very distinguished gathering. Five shots were fired into the water with fine effect in three which were charged with 92 per cent explosive. These were exploded successfully by Merriam fuses.

Target practice with dummy shells loaded with four pounds of gunpowder and with different fuses came next, in the course of which one of the shells exploded in the gun, blowing out a piece of the firing tube and slightly wounding two of those present. Had the premature explosion occurred with one of the fully charged shells, the results would have been most disastrous. As it is, the accident will simply lead to the discarding of the type of fuse which seems to have



THE PROJECTILES FOR THE DUDLEY GUN.

brought about the accident. One of our views shows the gun after the disaster, with a piece blown out of the central section of its firing tube.

A feature of the gun is the slight recoil, and consequently slight foundation needed to carry it. A couple of timbers to which the standard is bolted are ample. It could be established on a ship's deck without any additional bracing being required, and its simplicity and lightness of parts adapts it for field use. It places the pneumatic gun on a par with field artillery, something hitherto not effected.

### Semi-Precious Stones.

Mr. George F. Kunz, the acknowledged authority on precious and semi-precious stones, communicates to the New York Sun the following interesting facts relative to the discovery and source from which collectors and museums obtain their specimens, and a description of the properties of which the different stones are composed.

Public interest in the fancy or semi-precious stones has increased greatly in America since the Centennial Exposition of 1876. Formerly jewelers sold only diamonds, rubies, sapphires, emeralds, opals, pearls, garnets, and agates, but now it is not unusual for the mineralogical gems, such as zircon, star sapphire, star ruby, tourmaline, spinel, or titanite, to be called for, not only by collectors, but also by the public, whose taste has advanced as much in precious stones as it has in art.

Spinel is the most valuable of the semi-precious stones, and is one of the few minerals that are ornamental and beautiful enough for gems in their natural state. No other stone has so wide a range of color, and each color in turn is represented by many distinct shades. The flame red and crimson stones have been mistaken and sold for rubies, but, although the hue may be vivid, yet it lacks the richness of the ruby. The orange red spinels are called rubicelles, the pink ones balas rubies, and a charming variety of blues, blue greens, inky blues, purples, and violets, terminating in the black spinel, called pleonaste, gives this stone a range of color almost unequaled.

One would little expect to find among the jewels of the queen of the ruby mines any other than true rubies; but the English officer who, in 1886, took the hairpin from the private chamber of Soup-Y-La, the Queen of Burma, in the palace of Mandalay, was surprised to find that the red jewel in it was not a true ruby, but a fine ruby spinel.

Beryl is one of the most lustrous and brilliant of gems, and occurs in a variey of shades of yellow, golden yellow, yellow brown, brown, green, sage, and grass green. Aquamarine is the term applied to the white, light green, light blue, and yellow green beryls, so called from their resemblance to the color of sea water. The yellow ones have been called golden beryls. All these varieties are often exceedingly beautiful and brilliant. The finest aquamarines are found in Russia, Brazil, Ceylon, Maine, New Hampshire, Connecticut, and Mount Antero, Colorado; at the last locality, at an elevation of 14,000 feet, almost on the line of perpetual snow.

The large aquamarine now at the Field Columbian Museum in Chicago, the finest ever found in the United States, is from Stoneham, Me. It is brilliant cut and weighs 133¾ carats. The color is light bluish green, and, with the exception of a few hairlike internal striations, it is perfectly clear. One of the finest known beryls is a superb blue green crystal, found in the Urals in 1820, weighing six pounds, and valued at $28,000. It is now at the School of Mines in St. Petersburg. Others worthy special attention are the one in the sword hilt of Prince Murat, sold in the Hope collection, and the frog of sea blue aquamarine on a jade leaf, shown at the Paris Exposition of 1878, and now in the James Garland collection in New York City.

The name topaz generally suggests only a yellow stone, yet there are light blue and green varieties which have frequently been sold as aquamarines, though the topazes are heavier than aquamarines, and I have frequently detected the difference without opening the paper containing them. Topaz admits of a very high polish, and is very slippery to the touch. Strange to say, the yellow topaz when slightly heated becomes pink; heated further, the pink grows paler, and by long heating is entirely expelled, leaving the gem colorless. The sherry colored or brown topaz is bleached in a very short time by the rays of the sun, or strong daylight, and all the white topazes found in nature have been decolorized in this way. The topaz is found in granite rocks in Siberia, Japan, Peru, Ceylon, Australia, Brazil, and Maine, and in volcanic rocks in Colorado, Utah, and New Mexico.

One of the most beautiful of all gems, and one not known two decades ago, is the green garnet called demantoid, or "Uralian emerald," or "Bobrowska garnet," found at Poldnew aja, near Sysserk, in the government of Orenberg, Russia. It varies from yellowish green to an intense emerald color, and has such a power of refracting light that it shows a distinct fire like the diamond or zircon, and in the evening has almost the appearance of a green diamond.

Pyrope, or Bohemian garnet, has been long and extensively sought and worked in the region near Meronitz, Bohemia, where it is gathered from surface deposits and conglomerate rocks, coming from a decomposed peridotite. The gathering and cutting form a great industry in that country. Pyrope occurs under similar conditions in the diamond bearing rocks of South Africa, and also in Arizona and New Mexico; and from both these regions gems of rich color are obtained and sold under the name of Cape rubies and Arizona rubies. The African stones are larger than the American, and perhaps equal to them in color by daylight, but the latter are much richer by artificial light. Only the clear blood red color then remains visible, while the Cape rubies retain a dark tint, inclining to brown. About $5,000 worth of cut stones from Arizona are sold annually, and some peculiarly fine ones have brought from $50 to $100 each.

The torquoises of commerce come from Nishapur, Persia, the Desert of Sinai (Egyptian turquoise), and several localities in New Mexico. Those from Persia are of a softer blue and opaque; those from Egypt a darker blue and translucent, frequently changing to green; those from New Mexico are a fine blue, and fully half a million dollars' worth has been sold in the past five years. The best specimens come from Nishapur, where they occur in a clay slate. There is in the color of the best turquoises a peculiar quality partly arising from the fact that the delicate blue tint is mingled with a slight infusion of green and partly from a faint translucency of the stone. Turquoise is not opaque, thin splinters transmitting light easily, and cutting and scraping like ivory with a polished cut.

The true turquoise, which shows various hues and tones of blue, greenish blue, bluish green, is not to be confounded with the blue fossil turquoise, or odorntolite, which is a fossil bone, colored by phosphate or iron.

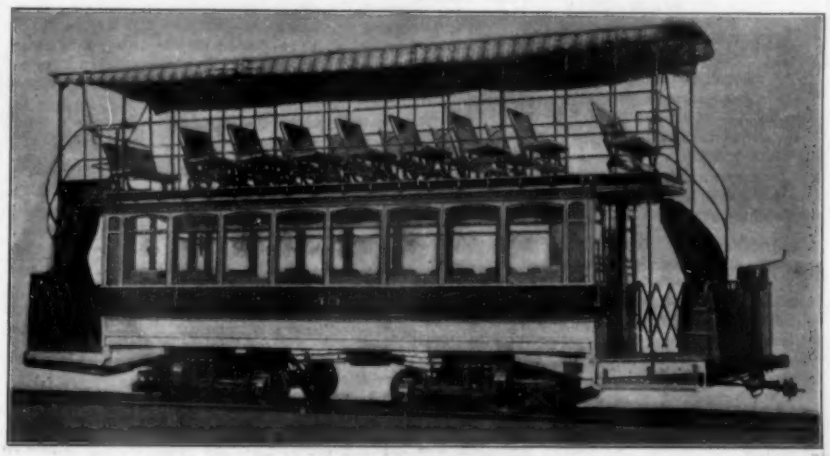
Turquoise often becomes green by age, as may be frequently seen in turquoise cameos of the Italian cinquecento. When green spots appear on turquoises the color can often be restored by allowing them to remain in a solution of equal parts of alcohol and ammonia, or embedding them for a time in fuller's earth wet with alcohol or water. These spots are often due to the absorption of grease or other fatty compounds which separate from the soap when the hands are washed, or to the action of perfumes which leave oily essences upon evaporation. Sometimes, however, they result from a natural change, and hence this beautiful gem cannot be guaranteed, although the owners of the American mines replace any stone that changes color within six months. In a coronation chair in the Kremlin are several old turquoises, some of which are beautifully blue, while others in the same chair have changed to green. Turquoise has been found all the way from Colorado to Peru.

### Negative Varnish.

Dissolve eight parts of borax and two parts of carbonate of soda in one hundred and sixty parts of hot water, and dissolve in this thirty-two parts of bleached shellac broken up small. When this is dissolved add one part of glycerine dissolved in one hundred and sixty parts of water. If any deposit forms after a few days, filter off. This varnish can be run on the plate while it is wet, hence the plate dries once for all.—Photography.

### DOUBLE DECK CARS.

It was suggested in a recent issue of the SCIENTIFIC AMERICAN that the congestion of traffic on important lines of travel, such as the Broadway cable line, New York, might be relieved by the introduction of a certain number of double deck cars. There is an objection to the use of trailers on the ground of obstruction to traffic on the intersecting streets, which would not obtain against this form of car. It provides, upon a single wheel base, the same passenger accommodation as two ordinary cars. Its introduction on a line running through a crowded thoroughfare would double its carrying capacity without adding to the bulk of the vehicular traffic. The accompanying engraving shows the general appearance of a number of twenty-two foot double deck electric cars, built by the J. G. Brill Company, for the new electric railway in Cape Town, South Africa. They have a seating capacity of sixty-four passengers, thirty-two above and thirty-two below. The seats on both decks are arranged transversely, with a central aisle.



DOUBLE DECK CARS.

It will be seen that the increase of 100 per cent in the seating capacity is obtained at the cost of comparatively little extra dead weight in the car itself, which, in its essential features, is similar to the ordinary single deck car. The increased accommodation is obtained by the addition of a roof carried on light iron rods, two end stairways, and the seats, together with such increase in the strength of the car body and frame as may be necessary. The platforms are specially commodious, and accommodation is provided for the motorman, controller and brake apparatus on the outside of the step landing. The cars are mounted on Eureka maximum traction pivotal trucks, and are equipped with Westinghouse No. 38 50 horse power motors. We are indebted for illustration and details to the Street Railway Journal.

### THE DOUBLE DOVETAIL AND BLIND MORTISE.

BY EMERY LEVERETT WILLIAMS.

There are many peculiarly ingenious devices used by cabinet makers in the nicer parts of their work.

Often these tricks serve the purpose of making a finer finish or a better construction, and are frequently invented by some clever mechanic.

I remember when a boy, and interested as most boys are in the possibilities of a jackknife and a small set of carpenter's tools, seeing my father construct a double dovetail, which to me appeared an impossible feat. That it could be put together so as to be dovetailed in both directions, might well surprise many better acquainted with woodwork than I.

Like all things apparently intricate, its secret is simplicity; but when both pieces are glued tightly together, as shown in the drawing, it is a puzzle.

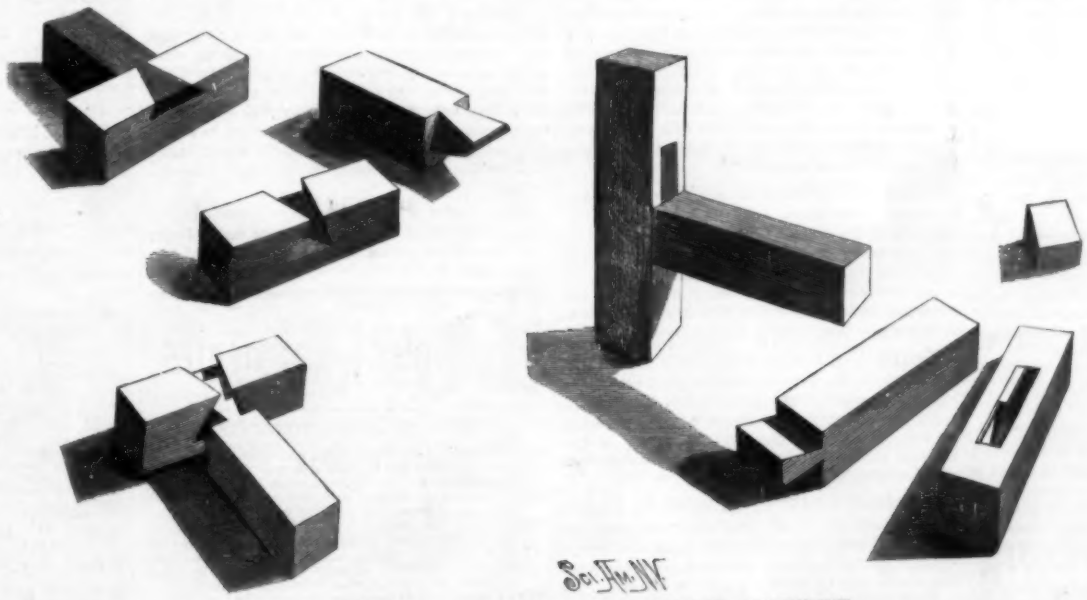
It is constructed like a simple wedge, the cut in the wood where the dovetail is inserted being entirely hidden when the pieces are together.

Inserting the dovetail at the wide cut on the side, it is pressed into place, wedging itself easily and nicely into the position showing a double dovetail.

I am not sure that this particular dovetail has any practical value, otherwise than making a nice finish, as its strength is only in one direction.

At another time my father was engaged in repairing some antique furniture, among which were some old English chairs. The gentleman who owned these called my father's attention to one, the legs of which were braced by rungs, still tight and secure as when made. Under each rung, in the leg of the chair, was a wooden plug, its grain running exactly as that of the leg. It seemed as if a mistake had been made by the one who built the chair, he having evidently made the mortise cut too low and had tried to hide his error by filling it with this wooden plug. After a moment's inspection, my father saw that this was not a mistake, but an old English trick, called a blind dovetail.

A cut is made in the leg of the chair twice as long as the width of the rung, the lower half of which is as wide again as the upper. The end of the rung is a half dovetail. This is inserted into the wide lower cut and pushed upward into place, in the upper half, which is cut to fit the dovetail closely. When this is glued, the plug is driven into the lower part, filling it and holding in place the rung, which cannot become loosened and drop out, as modern chair rungs so frequently do. This, although not so clever in construction as the one previously described, is nevertheless ingenious and of great service practically. To those woodworkers who care to put so much work into building a chair or other piece of furniture, this would be of especial value.



THE DOUBLE DOVETAIL AND BLIND MORTISE.

### Making Petroleum-tight Joints.

The following useful notes have been communicated by Mr. Hiram S. Maxim to the Engineer on the materials and methods for making tight joints in petroleum pipes and vessels: "Many have supposed it to be quite impossible to make a petroleum joint that would not leak, especially with the light varieties, such as naphtha and gasoline, when subjected to both heat and pressure. However, as a matter of fact, it is no more difficult to make a petroleum-proof joint than a waterproof joint. In making up steam or water joints we naturally employ something which is insoluble in water. If an ordinary steam or gas fitter is asked to make a petroleum-tight connection, he is sure to employ red lead and oil, and for a gasket or washer he is equally sure to use India rubber, both oil and India rubber being quite soluble in petroleum. In my experience I find that a joint which is screwed together dry is less apt to leak petroleum than a joint made up of the orthodox red lead and oil. To make a good petroleum joint with common iron pipes, a very good system is to heat both the male and female threads sufficiently to dissipate every trace of oil; then make the joint up with thick shellac varnish, which may be combined with ordinary dry vermilion or even Venetian red. A joint of this kind I have found to stand well. A very good joint can also be made with ordinary yellow bar soap rubbed into the threads of the pipe, the grease being first removed. Molasses, honey, glue, mucilage, or glycerine are quite petroleum-proof. For a stuffing box, ordinary wicking saturated with common yellow bar soap may be safely employed. Canvas saturated with shellac varnish makes a good washer, but soft metallic washers are better. A very good flexible diaphragm for a regulator may be made of closely woven cotton fabric varnished on both sides with a compound of gelatine and glycerine. About equal parts by weight make a very tough and elastic compound. Wooden vessels, bags, etc., may also be made petroleum-tight by saturating or varnishing with this compound. As a rule, all substances which are soluble in water are quite insoluble in petroleum. For stuffing boxes for withstanding both water and petroleum, castor oil may be employed, as this peculiar oil seems quite insoluble in either water or petroleum."

### Injuries by Electricity.

The use of electricity has become so general and accidents are so frequent that everybody should be advised how to extend aid to a person injured by an electrical current. A German medical publication gives the following suggestions: (1) The current should be shut off at once if the means are at hand and the person called upon understands how to do it. (2) If this cannot be done, be careful not to touch the injured person's body with the hand. If no India rubber gloves are at hand, the body should be dragged away from the wires by the coat tails, or the coat should be taken off and folded (a dry cloth may be used for the purpose), when the injured person may be grasped through it and dragged away. (3) When it is not possible to remove the injured person from the wires, raise that part of the body that is in contact with the earth or the wire from it, using the covered hand. This will break the current, and it will generally be possible then to get the body away. (4) If this cannot be done, take a dry cloth and place it between the body and the ground, and then disentangle the body from the wires. (5) If the body is freed from the wires, remove all the clothing from the neck and treat the injured person as one drowned. Open the mouth and grasp the tongue, which should be covered with a cloth; then pull the tongue forward and gradually allow it to fall back; this movement should be repeated sixteen times a minute. Take care that the root of the tongue is thoroughly moved. (6) The bystanders should not be allowed to give the injured person wine or liquors.

### How Colds Are Taken.

A person in good health, with fair play, says the Lancet, easily resists cold. But when the health flags a little, and liberties are taken with the stomach, or the nervous system, a chill is easily taken, and according to the weak spot of the individual, assumes the form of a cold or pneumonia, or, it may be, jaundice. Of all causes of "cold" probably fatigue is one of the most efficient. A jaded man coming home at night from a long day's work, a growing youth losing two hours' sleep over evening parties two or three times a week, or a young lady heavily "doing the season," young children over-fed and with short allowance of sleep, are common instances of the victims of "cold." Luxury is favorable to chill-taking; very hot rooms, feather beds, soft chairs, create a sensitiveness that leads to catarrhs. It is not, after all, the "cold" that is so much to be feared as the antecedent conditions that give the attack a chance of doing harm. Some of the worst "colds" happen to those who do not leave their house or even their beds, and those who are most invulnerable are often those who are most exposed to changes of temperature, and who by good sleep, cold bathing and regular habits preserve the tone of their nervous system and circulation. Probably many chills are contracted at night or at the fag end of the day, when tired people get the equilibrium of their circulation disturbed by either underheated bedrooms and beds. This is specially the case with elderly people. In such cases the mischief is not always done instantaneously, or in a single night. It often takes place insidiously, extending over days or even weeks.

A MASTODON'S skull, in a fine state of preservation, was dug up at Buchanan, Mich., near the Indiana boundary, a few days ago. It measures 2½ feet in width and has four perfect teeth. The teeth measure about 4 inches by 6½ inches.

## Business and Personal.

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## RECENTLY PATENTED INVENTIONS.

### Railway Appliances.

CAR FENDER.—Sylvanus D. Wright, New York City. This fender has a forwardly-extending U-shaped frame supported in position by chains connecting its side bars with the dashboard, the frame being adapted to spring backward slightly on striking a person in the path of a moving car. The platform held in the frame is made of wire netting, and at its rear has a slightly curved back to form a head rest and protect the body of any one picked up by the fender, the body being safely held until the car is stopped. The improved device may be readily disconnected from one end of the car and placed at the other end.

SWITCH.—John Kesselring, Girardville, Pa. This invention affords an improvement in switches which automatically return to a certain normal position, there being adjacent to the switch tongue a mating rail with transversely movable portion, and a guard rail alongside the mating rail, while extending through the mating rail and guard rail is a rod on which are springs to press the mating rail of the switch tongue toward the guard rail. All the parts return to their normal positions as soon as the train leaves the portion of the track adjacent to the switch.

CAR AXLE LUBRICATOR.—James S. Patten, Baltimore, Md. This inventor has patented, in one integral device, a brass or journal bearing proper, a journal cap or hood-like cover and protector, and means for deflecting and confining the oil within required limits, the pendent front and sides of the cap or hood diverging from a point in contact with the journal and having near their rear ends transverse ribs extending downward from a point where they are in frictional contact with the journal. There is also provided a spring-supported oil box in which are oil take-up rollers.

### Electrical.

STORAGE BATTERY.—Alexander F. Vetter, New York City. This is a battery of simple and inexpensive construction in which the active material is positively held in the plates, positive connections with the plates being effected by arms connected integrally with the metal thereof. Ordinary lead pipe is used, the sides pressed together to close the tube at its lower end, the tube being cut away at its upper end, forming a half tube extension, the active material being then placed in the tube section and the top of this portion being closed by pressure. Outside or end plates constituting the negative elements have downwardly inclined openings on their inner faces, the outer surface being left intact, and the positive plate is similarly perforated in both sides.

ELECTRIC LIGHT SHADE.—Willis E. Robinson, Faribault, Minn. According to this invention, a shield is provided consisting of a clamp having at one end an open loop, while at its opposite end is pivoted a holder carrying a spring maintaining the holder in adjusted position relative to the clamp, the holder also carrying a shading leaf. The improvement is more especially adapted for incandescent lamps, being adjustable vertically and laterally or at any angle to the light.

ELECTRIC SWITCH.—Abraham K. Dresher, Worcester, Pa. In this switch the space between the stationary and movable contact surfaces is great when the switch is open and small when the switch is to be closed, that the switch may make a long break and a short make, an automatically adjustable contact spring being provided and a novel binding post to hold it and receive the conducting wire. The mechanism for causing a long break and a short make is formed of long and short spring and wedge cams, and by making the movement necessary to complete the circuit small it is made possible to make the movement for breaking the circuit larger, thus avoiding arcs.

### Mechanical.

BOOKBINDER'S RASPING MACHINE.—Edward J. Campbell and Patrick J. Haggerty, Brooklyn, N. Y. This machine comprises a frame in which reciprocates a slide carrying a graduated series of rasping devices adapted to act successively on the work, while means are provided for moving the work transversely to the slide. The machine mechanically produces the ragged or jagged edges heretofore made by hand on the front and bottom edges of a book to imitate the natural rough edge of hand-made paper.

BOX MAKING MACHINE.—Hiram Goo and Stuart B. Hopkins, Delevan, N. Y. This invention consists principally of a head-clamping device having an intermittent rotary motion and a nailing device in conjunction with the clamping device, to drive the nail into the hoop and head when the rotary motion of the clamp ceases. It is more especially designed for making cheese boxes, etc., and bends a strip or band of wood into a hoop, at the same time nailing one side on the head or side of the box and tacking the overlapping ends of the hoop, cutting off the surplus material of the hoop to finish the box.

### Agricultural.

STEAM PLOWING APPARATUS.—Edward Ingleton, Pottstown, Pa. This is an improvement on a formerly patented invention of the same inventor, and comprises a wheel-supported frame carrying tracks moved by endless chains and chain wheels, carriages in which are adjustable plow shanks, and trip devices which raise and lower the plow shanks on the carriages. The cost of manufacture is lessened and the construction simplified, the chain of plows being made to travel at the side of the frame instead of at the top and bottom. Improved means are also provided for raising and lowering the plows, and effecting the connection between the plowing apparatus and the traction engine or other motor moving the apparatus.

### Miscellaneous.

STARTING RACE HORSES.—James J. Sullivan, New York City. To insure fair and prompt starts in racing this inventor has devised a screen to be stretched across the track in front of the horses to prevent the passage of any of the horses before the proper time. The screen frame is connected by link hinges with supports at the sides of the track, and on the given signal the screen is swung forward and upward out of the way by men working in concert and pulling on the ropes attached to the upper ends of the side bars of the screen frame.

SNOW MELTING MACHINE.—Burton S. Craig, Clinton, Iowa. In this machine an elevator and conveyor receives the snow scraped up by a shovel, there being a tank beneath the conveyor, and boiler and pipes to melt the snow so arranged as to confine the heat and utilize it to the utmost extent, the melted snow being conducted to the tank, and then to a gutter or ditch at the side of the road. The machine may be drawn by horses or driven by a motor, and a brush at the rear of the machine sweeps the loose snow into the gutter.

PHOTOGRAPHIC CAMERA.—Alejandro Gual y San Juan, Havana, Cuba. This inventor provides an objective which will be light-tight and free from projecting parts, avoiding all danger of fogging by light entering through the slit in which the diaphragm moves. By means of a series of apertures of different sizes the time of exposure may be varied in the same manner as the lens camera, the focusing being made with the aperture yielding the clearest image and the exposure being made with a different sized aperture.

SOLDIERS' INTRENCHING TOOL.—James H. Gageby, United States Army (Fort Niobrara, Neb.) The blade of this tool has two shanks, connected by a transverse handle, and a second handle extends down in front of the blade, the whole being made of one piece of metal, and forming a light, strong and efficient tool which may be used by a soldier lying down or kneeling, there being no long handle or awkward leverage.

THILL COUPLING.—William Horning, Johnstown, N. Y. This is a device of very simple and inexpensive construction designed to hold the thills securely without limiting their free swinging movement on the axle. It is also so constructed that it may be conveniently adjusted to take up looseness resulting from wear, and rattling is prevented.

VEHICLE SHAFTS.—Charles A. Floyd, London, England. According to this improvement the front end of each shaft is made with a terminal loop or eye to which the back band is attached, and the loop has also a cross stay to which the trace is attached. The ordinary projecting ends of the shafts are thus dispensed with, and there is less danger of injury to other animals in case of collision, or of injury to a horse falling in harness.

LOCK.—Wilson T. Bohannan, Brooklyn, N. Y. This inventor has devised a key guard for ordinary latches or locks, rendering them more secure. It consists of a guard adapted to be introduced into the key sleeve, and having adjustable wards, so that a number of combinations may be made, and the same style of lock be made to require different keys. The wards of the guard are also so made that the key can be turned only in one direction.

SASH BALANCE.—Joseph H. Bane, Barre, Mass. This is a frictional device, in which weights are not employed, and which is also readily adjustable to counterbalance any window sash that may be placed in the frame. A pivotal housing carries an adjustable spring adapted to engage a fixed support, a friction wheel in the housing engaging the sash, while disks in the housing have ratchet wheels engaged by pawls carried by the friction wheel. The sash may be raised with but little effort, but more exertion is required to lower it, and it may be readily held and locked at different points.

GAS STOVE.—Robert Morton and Robert Pringle, London, England. This stove has an air heating chamber above the combustion chamber, upcast gas flues being suspended from the top of the air heating chamber and opening into the combustion chamber, below which are the burners, while the gas supply connects with a gas heating chamber in one of the flues, with other novel features, the arrangement of the air tubes and other parts of the stove being so proportioned and the consumption of gas and air so adjusted that the flames burn with a pure white light and perfect steadiness, and do not impinge on any part of the stove.

HOOK AND EYE FASTENING DEVICE.—Joseph Matthews and Kennon Mott, Brunswick, Ga. The hook and eye, according to this invention, are each made of a single piece of bent wire, and each has two sharp points adapted to be attached to a garment by two motions, or removed therefrom by reverse movements. After the hook is in the garment its points or pins may be threaded in the under face of the garment, or covered by a sewed-on strip of material.

DRESS BELT.—Henry Bruning and Edward Ross, Brooklyn, N. Y. This is a sectional leather belt having front end sections united to a rear or back section by a ring at each side, the front end sections being closed by a buckle. The strap adjacent to the connecting rings has an embossed or offset recess, whereby a fine appearance and increased strength is given to the belt.

CLOTHES LINE CONVEYER.—Alexander G. Molteni, Hoboken, N. J. This is a simple and inexpensive device to be secured to the outer side of a window or door casing, over which a clothes line may be passed, the other end of the line being extended around a pulley on a distant post or other support. With this improvement the sheave carrying the pulley line may be secured in almost any position without rendering necessary any change of the parts.

ROTARY BRUSH.—William S. Beard, Pine Bluff, Ark. For dusting rooms, and brushing suits, dresses, etc., this inventor has devised a brush to be rotated by spring power, and which at the same time collects the dust removed. It comprises a spring motor in a casing driving a train of gear wheels which drive a brush shaft, end brushes being held on the extreme outer ends of the shaft, and a receptacle for the sweepings projecting forward under the brushes and being secured to the under side of the casing.

CLEANING BEER PIPES, ETC.—Charles Peters, Brooklyn, N. Y. For forcing a cleaning liquid through pipes and cocks in apparatus for dispensing beer, according to this invention, a cleaning liquid receptacle is connected with a compressed air supply, and connection is also made with the pipes to be cleaned, in such manner that the column of cleaning liquid supplied, instead of being driven at a constant speed, is periodically arrested or checked in its motion, to produce a shaking action of the pipes.

SHOW CASE.—John Conlin and Robert Whitty, Ripon, Wis. This invention consists principally of a casing provided with a cover hinged to a frame mounted to swing, the improvement being more especially designed for exhibiting cigars and similar articles, and permitting the shopkeeper to open the case for a preferred customer to select and remove the desired goods, or to open it only so that only the shopkeeper can take out the goods.

DISPLAY HOOK AND PRICE CARD HOLDER.—Frederick W. Polster, Johnstown, Neb. This is a simple and inexpensive device made of spring wire, and having clamping arms to clamp the goods, one of the arms having projecting side portions on opposite sides of and guided on the other arm, the projecting side portions being connected and braced by a clip adapted to hold a price card or ticket. The device affords a secure means of supporting goods for display, with attached price card or ticket.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co., for 25 cents each. Please send name of the patentee, title of invention, and date of this paper.

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**Books** referred to promptly supplied on receipt of price.

**Minerals** sent for examination should be distinctly marked or labeled.

(6837) S. N. S. says: Please state approximately the total horse power in use in the United States and world. A. The following figures of the world's steam power are given by the Bureau of Statistics in Berlin. Of the steam engines now working in the world, four-fifths have been constructed during the last twenty-five years. France has 79,800 stationary and locomotive boilers, 1,850 boat boilers, and 7,000 locomotives; Germany, 59,000 land boilers, 1,700 ship boilers, and 10,000 locomotives; Austria, 12,000 boilers and 2,900 locomotives. The working steam engines of the United States represent 7,500,000 horse power; of England, 7,000,000 horse power; Germany, 4,500,000 horse power; France, 3,000,000 horse power; Austria, 1,500,000 horse power. This estimate does not include the locomotives, whose number in the world is 105,000, representing a total of 3,000,000 horse power. The world's steam engines, therefore, aggregate more than 26,000,000 horse power, equivalent approximately to the work of 1,000,000,000 men.

(6838) R. P. B. writes: I wish to know if an induction coil, wound with No. 36 silk covered wire entirely across the spool, is just as effective as if it were wound in two sections, the same being insulated in the best possible manner. What is the idea of making the coil in two sections? Winding the coil clean across is much easier, and, if it is just as good for the purpose intended, I would prefer to do so. How many cells of battery do you think I would need to produce X rays with the coil 7½ inches long recently illustrated in the SUPPLEMENT? A. The object of winding a coil in sections is to keep a good distance between leads in the secondary differing greatly in potential. It is advisable to use more than two sections. Six or eight cells should suffice for X ray work, but you must anticipate much difficulty and probable disappointment. Your coil seems far too small.

(6839) A. S. C. writes: I am about to use a small powerful battery. Which kind should I use? A. Storage batteries are incomparably the most powerful. They are described in our SUPPLEMENT, Nos. 150, 398, 845, and 907. Primary batteries are given in great variety in the SUPPLEMENT, especially Nos. 157, 158, 159, 792. For a large bichromate battery of high power, see No. 792.

(6840) M. N. asks if he can run a battery motor with a 110 or 220 volt circuit if he puts resistance boxes in. If this is possible, how may he determine how much resistance to put in to get a required current. A. If you have 110 volt lamps, each one will pass ½ ampere. Therefore, arrange in parallel twice as many lamps as your motor will take of amperes and let them act as resistance.

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**AND EACH BEARING THAT DATE.**

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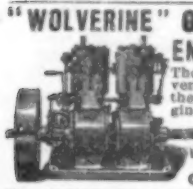

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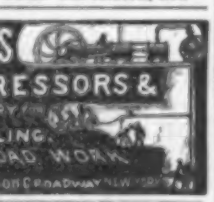

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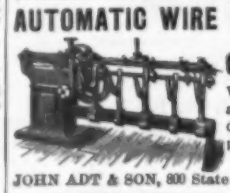

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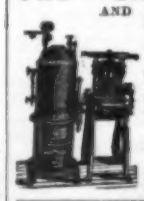

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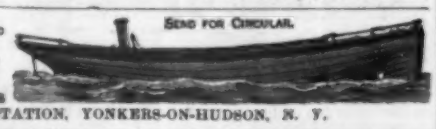


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